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Thomas A Edison Papers

A SELECTIVE MICROFILM EDITION

PART II
(1879–1886)

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University Publications of America
Frederick, Maryland
1987

Thomas A. Edison Papers
at
Rutgers, The State University
endorsed by
National Historical Publications and Records Commission
18 June 1981

The original documents in this edition are from the archive at the Edison National Historic Site at West Orange, New Jersey.

THOMAS A. EDISON PAPERS

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A Note on the Sources

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THOMAS A. EDISON PAPERS

A SELECTIVE MICROFILM EDITION
PART II
(1879-1886)

REEL 29

NOTEBOOK SERIES (NBK-7)

Menlo Park Notebooks, #1 - #10

NOTEBOOK SERIES, 1879-1886

Several sets of technical notes and drawings comprise the Notebook Series for 1879-1886. They appear on the microfilm in the following order: (1) Menlo Park Notebooks, (2) New York Notebooks, (3) Fort Myers Notebooks, (4) Lamp Factory Notebooks, (5) Pocket Notebooks, (6) Technical Scrapbooks, (7) Unbound Notes and Drawings, (8) Oversize Notes and Drawings, (9) Undated Notes and Drawings. All of the bound notebooks, except for the technical scrapbooks and the pocket notebooks are standard-size, 6 inch x 9 inch notebooks containing between 280 and 290 pages. Edison began using these notebooks in November 1878, and he continued to use them throughout the remainder of his life.

(1) Menlo Park Notebooks, 1878-1882. These notebooks are the principal sources for documenting the invention and development of Edison's system of electric lighting and power. They also contain much material on the telephone, as well as scattered entries detailing work on electric railways, batteries, ore separation, telegraphy, and various other technologies. The entries in the early notebooks are primarily by Edison, Charles Batchelor, and Francis Upton. As the staff of the laboratory expanded, many other individuals began making entries in the notebooks. A few of the books contain entries from 1883, 1884, and 1885. The notebooks are numbered from 1 to 249. Approximately 70 books are missing from the set.

(2) New York Notebooks, 1884-1886. These ten notebooks were used at Edison's New York City laboratory, which was located above the offices of Bergmann & Company at Avenue B and 17th Street. Most of the notes, drawings, and calculations are by Edison. There are also some entries by John F. Ott, Ezra T. Gilliland, H. DeCoursey Hamilton, Montgomery Waddell, and other laboratory assistants. The books deal with a wide variety of subjects, including electric lighting and power, telephony, telegraphy, mining, and the phonograph. Several books contain entries pertaining to Edison's search for a new force and his attempt to convert heat directly into electricity.

(3) Fort Myers Notebooks, 1886. These seven notebooks were generated at Edison's winter home in Fort Myers, Florida, which he constructed shortly before his marriage to Mina Miller in February 1886. Most of the entries are by Edison. There are also some entries by Mina Miller Edison, whose name also appears in these books as a witness. Many of the notes and drawings concern phonoplex and multiplex telegraphy, Edison's search for a new force, and his attempts to convert heat directly into electricity. There is also material relating to electric lighting, electric railways, spectroscopy, hearing aids, and numerous other items. One book contains notes about the layout of the grounds at the Fort Myers home.

(4) Lamp Factory Notebooks, 1886. These seven notebooks contain notes, drawings, and calculations relating to experiments performed at Edison's lamp factory in Harrison, New Jersey. Most of the entries are by Edison and John F. Ott. One book contains entries by Mina Edison. Another book was used primarily by Ezra T. Gilliland. In addition to the lamp experiments, these books also contain notes and drawings pertaining to telephones and phonographs, along with some material dealing with the phonoplex and with other systems of railway telegraphy.

(5) Pocket Notebooks, 1878-1886. These are a group of miscellaneous books, generally measuring about 3 to 4 inches in width and 6 to 7 inches in height. Included among the pocket notebooks is a set of six journals kept by Charles P. Mott between March 1880 and March 1881 to record daily activities at the Menlo Park Laboratory. The other eight pocket notebooks were used primarily by Edison. The entries relate to a wide variety of topics, including electric lighting, telephony, telegraphy, the phonograph, and hearing aids.

(6) Technical Scrapbooks, 1881-1888. These seven disbound scrapbooks contain notes and drawings by Edison, which he subsequently gave to his attorneys and draftsmen to work into patent applications. Most of the material concerns electric lighting but there are also entries relating to telephony, telegraphy, electric railways, and other topics.

(7) Unbound Notes and Drawings, 1879-1886. This set of technical notes and drawings relates primarily to electric lighting. Other topics include telephony, telegraphy, and electric railways. The documents appear on the microfilm in chronological order.

(8) Oversize Notes and Drawings, 1879-1886. This is a set of technical documents, primarily drawings, that are too large to fit in standard-size document folders. Most of the material relates to electric lighting. A few drawings concern telephones and electric railways. The documents appear on the microfilm in chronological order, but many of them are undated. Included also among the oversize notes and drawings is a separate set of Menlo Park machine shop drawings, dating from 1879 and 1880. These drawings were produced by the staff of the laboratory's machine shop prior to the production of experimental devices and models. Almost all of the drawings relate to work on the electric light, but there are a few miscellaneous drawings of the telephone.

(9) Undated Notes and Drawings. These technical documents relate primarily to electric lighting. Other topics include telephony, telegraphy, and electric railways. The notes and drawings appear on the microfilm in the following order: (a) Menlo Park period, 1879-1881; (b) New York period, 1882-1886; (c) drafts of caveats and patent applications.

Laboratory notebooks and other technical notes and drawings can also be found in the Charles Batchelor and Francis R. Upton collections (Special Collections Series).

Numbering Systems for Edison's Notebooks

Over the years a variety of different numbering systems have been employed by Edison and others to identify the notebooks used at Menlo Park and the later laboratories. Affixed onto the front cover of most of the standard-size Menlo Park notebooks is a label containing the inscription: "From the Laboratory of T. A. Edison. Menlo Park, N. J. No. _____." The numbers themselves run from 1 through 249 and were probably assigned to the books before they were put into use. The numbered books do not progress in strict chronological order, and related books sometimes contain widely separated Menlo Park numbers. About seventy of the numbered notebooks are missing from the collection at the Edison National Historic Site. There are also a few notebooks whose damaged labels obscure any numbers that may once have been affixed to them. This is the only numbering system that was consistently in use during the time the books were being used in the laboratory and, for this reason, the books are organized on the microfilm in the order of their Menlo Park number.

Many of the Menlo Park notebooks also contain a second numbered label affixed onto the front cover several inches above the Menlo Park label. These labels were probably added to the books during the 1890s at the time they were sent to the General Electric Board of Patent Control in New York City. With only a few exceptions, all of the books containing the second numbered label also have the Board of Patent Control's bookplate pasted onto their inside front covers.

For the first thirty-four Menlo Park notebooks, the two sets of numbers are identical. Thereafter, the second set of numbers progress in the same sequence as the Menlo Park numbers, but many of the notebooks lack the second number and the General Electric bookplate. Menlo Park Notebook #249, the last numbered book in the series, also has a second label bearing the number 147. Similar labels appear on a few other notebooks. Two of the New York notebooks are numbered 148 and 149. The six pocket notebooks used by Charles P. Mott are numbered 150-155, and one other pocket notebook is numbered 156.

Unlike the Menlo Park notebooks, the notebooks used at the laboratories in New York, Fort Myers, and the Harrison lamp factory do not contain a standard printed label or a standard notebook number. Some of these books, however, do have a small numbered label affixed to their spines. The numbers range from 23 to 35. Many of the Menlo Park notebooks lacking the General Electric bookplate contain similar labels, with numbers ranging from 2 to 22. These numbers were probably affixed to the books after Edison's move to West Orange in 1887. Over 100 books with these small numbered labels are found among the West Orange notebooks. Book 1 and Book 36 both date from 1887.

Beginning in the late 1930s, the archivists at the West Orange Laboratory began assigning "N-numbers" to the standard-size notebooks used by Edison at Menlo Park and the later laboratories. A similar number with the prefix "PN" was assigned to each of the pocket notebooks. This six-digit number corresponds to the first dated entry in the notebook. For example, a notebook whose first dated entry was for November 9, 1878 would carry the number N-78-11-09. Unfortunately, this number is not always a reliable indicator of the date when a book was first used. Many of the books were in use for a long period of time before any entry was dated, and hundreds of other books contain no dated entries. Moreover, subsequent research has revealed that many of the supplied or conjectured dates are inaccurate. For these reasons, the N- or PN- number should never be used as the basis for dating a notebook.

The following is a list of all the standard-size notebooks and the various numbers that have been assigned to them.

List of Standard-Size Laboratory Notebooks, 1878-1886

MP#	Label #	Spine #	N-Number	Date	G.E. Bookplate
1	1		78-11-28	1878-1879	X
2	2		78-11-22	1878-1879	X
3	3		78-11-21	1878-1880	X
4	4		78-12-04.2	1878-1879	X
5	5		78-12-02	1878-1879	X
6	6		78-12-04.1	1878-1879	X
7	7		78-12-11	1878-1879	X
8	8		78-12-20.2	1878-1879	X
9	9		78-12-15.1	1878-1879	X
10	10		78-12-16	1878-1879	X
11	11		78-12-28	1878-1879	X
12	12		78-12-20.1	1878-1879	X
13	13		79-01-01	1879	X
14	14		78-12-31	1878-1879	X
15	15		78-12-20.3	1878-1879	X
16	16		79-01-21	1879-1880	X
17	17		79-04-21	1879	X
18	18		79-01-12	[1879]	X
19	19		80-03-26	1880	X
20	20		79-02-24.1	1879	X
21	21		79-04-08.1	1879	X
22	22		79-03-10.1	1879-1880	X
23	23		79-01-19	1879	X
24	24		79-01-14	1879-1880	X

MP#	Label #	Spine #	N-Number	Date	G.E. Bookplate
25	25		79-04-03	1879-1880	X
26	26		79-02-20.1	1879	X
27	27		79-02-14	[1879]	X
28	28		79-02-15.1	1879	X
29	29		79-02-15.2	1879	X
30	30		79-04-08.2	1879-1880	X
31	31		79-02-24.2	1879	X
32	32		79-03-10.2	1879-1880	X
33	33		79-01-00	[1879]	X
34	34		79-03-25	1879	X
35			[Missing]		
36			[Tannebaum Library, Dearborn]		
37	35		79-07-07.1	1879-1880	X
38	36		79-07-07.2	1879	X
39	37		79-11-21	1879-1880	X
40	38		79-03-31	1879-1880	X
41	39		79-12-09	1879-1880	X
41.2	40		79-10-18	1879-1880	X
42	41		79-12-19	1879-1880	X
43			[Missing]		
44			[Missing]		
45	42		79-04-09	1879	X
46	43		79-02-10	1879	X
47	44		79-03-20	1879	X

MP#	Label #	Spine #	N-Number	Date	G.E. Bookplate
48	45		79-07-05	1879-1880	X
49			[Missing]		
50		5	80-04-17	1880, 1884-1885	
51	46		80-03-29	1880	X
52	47		79-07-31	1879-1880	X
53			80-03-14	1880	
54			[Missing]		
55	48		80-01-28	1880	X
56	49		79-07-25	1879-1880	X
57	50		80-03-06	1880	X
58			80-01-31	1880	
59	51		80-01-26	[1879-1880]	X
60	52		80-10-25	1880	X
61			[Missing]		
62			[Missing]		
63	53		80-02-08.1	1880	X
64			[Missing]		
65			[Missing]		
66		3	80-02-08.2	1880	
67	54		80-01-02.1	1880	X
68	55		80-03-19	1880	X
69			[Missing]		
70	56		80-01-02.2	1880	X
71	57		80-01-03	[1880]	X
72		4	80-03-31	1880	
73	58		80-02-02	1880	X

MP#	Label #	Spine #	N-Number	Date	G.E. Bookplate
74	59		80-01-02.3	1880	X
75		6	80-06-10	1880	
76			80-01-30	[1880]	
77	60		79-06-16.1	1879	X
78	61		79-12-27	1879-1880	X
79	62		79-06-16.2	1879-1880	X
80	63		79-06-12	1879-1880	X
81			[Missing]		
82	64		80-03-15	1880	X
83			79-12-00	[1879-1880]	
84	65		80-01-02.4	1880	X
85	66		79-08-22	1879	X
86	67		79-09-18	1879-1880	X
87	68		80-10-23	1880-1881	X
88	69		79-08-28	1880-1881	X
89	70		80-02-06	1880	X
90			[Missing]		
91			[Missing]		
92			[Missing]		
93			[Missing]		
94			[Missing]		
95	71		80-00-03	[1880-1881]	X
96			79-09-20	1879-1880	
97			[Missing]		
98			[Missing]		
99			[Missing]		

MP#	Label #	Spine #	N-Number	Date	G.E. Bookplate
100	72		81-04-12	1880	X
101			[Missing]		
102	73		80-06-28	1880	X
103	74		80-06-29	1880	X
104	75		80-07-05	1880-1881	X
105	76		80-06-02	1880	X
106			80-09-28	1880-1881	
107	108		80-04-02	[1880-1881]	X
108	77		80-07-02	1880	X
109			[Missing]		
110	78		80-08-00	[1880]	X
111	79		80-08-18	1880	X
112	80		80-07-23	1880	X
113	81		80-06-14	1880	X
114	82		80-08-10	1880-1881	X
115		7	80-07-19	1880	
116		8	80-07-27	1880	
117			80-07-10	1880-1881	
118			[Missing]		
119	83		80-09-27	1880	X
120	84		80-11-25	1880	X
121	85		80-10-15.1	1880-1881	X
122			[Missing]		
123	86		80-08-17	1880	X
124	87		80-11-18	1880	X
125	88		80-11-16	1880	X

MP#	Label #	Spine #	N-Number	Date	G.E. Bookplate
126	89		80-07-21	1880	X
127	90		80-00-05	[1880]	X
128	91		80-00-06	[1880]	X
129	92		80-09-09	1880	X
130	93		81-00-02	[1880]	X
131	94		80-07-00	[1880]	X
132	95		80-08-13	1880	X
133	96		80-00-01	[1880-1881]	X
134	97		80-08-09	1880,1884	X
135	98		80-07-30	1880	X
136	99		80-08-11	1880	X
137	100		80-07-16	1880	X
138	101		80-12-17	1880	X
139	102		80-01-07	[1880-1881]	X
140	103		80-12-21	1880	X
141			[Missing]		
142	104		80-11-27	1880	X
143		22	82-11-14	1882-1883	
144			[Private Collection]		
145	105		82-12-04	1882-1884	X
146	106		79-02-20.2	[1880-1881]	X
147			[Missing]		
148	110		80-10-08	1880	X
149	111		80-10-15.2	1880	X
150	112		82-12-21	1882-1885	X
151	113		80-06-01	1880	X

MP#	Label #	Spine #	N-Number	Date	G.E. Bookplate
152	114		80-01-13	1880-1881	X
153	115		80-09-11	1880-1881	X
154			[Missing]		
155			[Missing]		
156			[Missing]		
157	116		80-12-24.2	1880	X
158		17	81-03-22	1881	
159			[Missing]		
160	117		80-06-16.2	1880	X
161			81-10-18	1881-1882	
162			[Missing]		
163			[Missing]		
164			[Missing]		
165	118		81-00-01	[1880]	X
166			[Missing]		
167		9	80-09-03	1880	
168			80-12-13	1880-1881	
169			[Missing]		
170			[Missing]		
171	119		80-10-12	1880	X
172	120		80-11-15	1880	X
173			[Missing]		
174	121		80-11-09	1880	X
175			[Missing]		
176	122		80-00-07	[1880]	X
177	123		79-03-00	[1880-1881]	X

MP#	Label #	Spine #	N-Number	Date	G.E. Bookplate
178			[Missing]		
179	124		80-00-02	[1880]	X
180			[Missing]		
181			[Missing]		
182			[Missing]		
183			[Missing]		
184	125		80-06-16.1	[1881]	
185			[Missing]		
186	126		80-12-24.1	1880-1881	X
187	127		81-01-00	[1881]	X
188		11	81-01-25	[1881]	
189	128		80-00-04	[1881]	X
190	129		79-07-12	[1881]	X
191	130		81-01-21	[1881]	X
192	131		78-12-15.2	1878	X
193			[Missing]		
194			[Missing]		
195			[Missing]		
196			[Missing]		
197	132		82-06-08	1882	X
198	133		82-05-10	1882	X
199			[Missing]		
200			[Missing]		
201	134		81-05-21	1881	X
202			[Missing]		
203		20	82-05-15	1882, 1884	

MP#	Label #	Spine #	N-Number	Date	G.E. Bookplate
204	135		82-05-26	1882-1883, 1885	X
205			[Missing]		
206	136		81-03-09	1881-1883	X
207			[Missing]		
208			[Missing]		
209			[Missing]		
210	137		81-00-03	[1881-1882]	X
211			[Missing]		
212		10	81-05-23	1881	
213	138		81-05-14	1881	X
214		13	81-02-20	1881	
215	139		81-02-04	1881	X
216			[Missing]		
217			[Missing]		
218			[Missing]		
219			[Missing]		
220		16	81-07-11	1881	
221			[Missing]		
222			[Missing]		
223	140		81-04-06	1881	X
224		12	81-01-29	1881	
225			81-06-10	1881-1882	
226		15	81-06-22	1881	
227		19	81-03-24	1881	
228	141		81-08-30	1881	X
229		18	81-03-23	1881	

MP#	Label #	Spine #	N-Number	Date	G.E. Bookplate
230	142		81-03-18	1881	X
231			82-08-28	1882-1883	
232			[Missing]		
233			[Missing]		
234			[Missing]		
235	143		81-09-03	1881	X
236	144		81-03-11	1881	X
237			[Missing]		
238		21	82-06-21	1882, 1885	
239			[Hammer Collection, Smithsonian]		
240	145		81-03-04	1881	X
241			[Missing]		
242			[Missing]		
243			[Missing]		
244	146		81-02-18	1881	X
245		14	81-03-15	1881	
246			[Missing]		
247			[Missing]		
248			[Missing]		
249	147		82-03-12	1882-1883	
?	107		80-02-16	1880	X
?	109		80-10-01	1880, 1882	X
?			81-04-02	[1881-1882]	
?			81-04-30	1881	
?		2	80-01-16	1880	

MP#	Label #	Spine #	N-Number	Date	G.E. Bookplate
			N-84-05-29	1884	
		23	N-85-05-22	1885	
		24	N-85-05-28	1885-1886	
			N-85-10-01	1885-1886	
		25	N-85-10-03	1885	
			N-85-12-06	1885-1886	
		26	N-85-12-08	1885-1886	
			N-86-04-28	1886	
	148		N-81-09-13.1	1880s	
	149		N-81-09-13.2	1880s	
			N-86-03-18	1886	
		27	N-86-04-03.1	1886	
			N-86-04-03.2	1886	
			N-86-04-03.3	1886	
			N-86-04-05	1886	
		28	N-86-04-07	1886	
			N-86-08-17	1886, 1887	
		35	N-86-06-28	1886	
		29	N-86-07-07	1886	
		30	N-86-08-03	1886	
		32	N-86-08-24	1886	
		31	N-86-08-25	1886	
		33	N-86-10-05	1886	
		34?	N-86-10-08	1886	

MENLO PARK NOTEBOOKS, 1878-1882

The Menlo Park Notebooks cover the period 1878 to 1882. Some of the books also contain entries from 1883, 1884, and 1885. These books are the principal sources for documenting the invention and development of Edison's system of electric lighting and power. They also contain much material on the telephone, as well as scattered entries detailing work on electric railways, batteries, ore separation, telegraphy, and various other technologies. The books generated during the first year of work on the electric light are primarily by Edison, Charles Batchelor, and Francis Upton. The names of other laboratory assistants frequently appear as witnesses. As the staff of the laboratory expanded, many other individuals began making entries in the notebooks.

The Menlo Park notebooks are numbered from 1 to 249. Approximately 70 books are missing from the set. Pasted onto the inside front cover of many of the Menlo Park notebooks is a bookplate with the inscription: "Library of the Board of Patent Control, 120 Broadway, New York. May 1, 1896." The words "General Electric" have been crossed out and the following notation added in red ink: "From Library 44 Broad St., N.Y.C." Many of these notebooks also contain labels tipped into various pages, describing the experiments that follow. These labels often enumerate patents relating to these entries or suggest that the entries were "unimportant" for defending patent claims.

All of the extant notebooks have been filmed with the exception of a few books that contain mathematical calculations without accompanying notes and drawings or that relate to routine shipping transactions. The books appear on the microfilm in the order of their Menlo Park number.

The following notebooks have not been filmed:

Notebook #75 [N-80-06-10]	(1880)
Notebook #136 [N-80-08-11]	(1880)
Notebook #142 [N-80-11-27]	(1880)
Notebook #151 [N-80-06-01]	(1880)
Notebook #161 [N-81-10-18]	(1881-1882)
Unnumbered notebook, N-80-01-16	(1880)
Unnumbered notebook, N-81-04-02	(1881-1882)

Assigning Dates and Authors to Menlo Park Notebooks

Initially, it was the practice for members of the laboratory staff to sign and date each notebook entry. However, as the press of work and the size of the staff increased, Edison and his associates sometimes neglected to sign and date their work. As a result, there are many notebooks containing only a few dated entries, and some of the books are entirely undated. There are several methods of assigning dates or date ranges to undated notebook entries. Sometimes two members of the staff recorded the same set of experiments in separate notebooks. In such cases, an undated set of notes in one book may be dated in the other book. Date ranges can be assigned to other undated entries by a careful examination of dated entries on the pages preceding and following the undated entry. Moreover, it is usually possible to determine the earliest date that a particular notebook could have been used by examining the cover of the book. The earliest Menlo Park notebooks (November 1878-April 1879) all have blue-green covers. The covers of the later notebooks are a variety of colors, including dark red, light blue and black, dark blue and black, and green-orange. An analysis of the notebooks with dated entries reveals that books with similar covers were usually generated during the same time period. Thus, it is possible to conjecture that an undated notebook with a light blue-black cover dates from the period April-December 1880 and that a notebook with a dark blue-black cover dates from the period after January 1881.

One other source is invaluable for dating notebook entries from 1880. There are two Menlo Park Notebooks and six pocket notebooks that were used by Charles P. Mott, a member of the Menlo Park office staff, to record the daily activities of the laboratory between March 1880 and March 1881. Mott sometimes included references to specific notebooks and mentioned the names of individuals working on specific projects, thus allowing the attribution of authors and dates to entries that could otherwise only be conjectured.

For the early books, which are primarily by Edison, Charles Batchelor, and Francis Upton, it is usually possible for a careful researcher to distinguish writing and drawing styles in cases where an entry is unsigned or more than one person signed the entry. For the later books it is more difficult to attribute authorship, but the Mott journals can help the researcher become familiar with the writing and drawing styles of the various staff members.

A more extended discussions of these issues can be found in Robert Freidel and Paul Israel, Edison's Electric Light: Biography of an Invention (New Brunswick: Rutgers University Press, 1986), pp. 233-238.

Menlo Park Notebook #1 [N-78-11-28]

This notebook covers the period November 1878-July 1879. Most of the entries are by Edison, Charles Batchelor, and Francis Upton. There are also entries by George E. Carman and George Jackson. The names of Martin Force and John Ott appear occasionally as witnesses. Almost all of the material relates to experiments on electric lighting. Included are notes and drawings of lamps; notes on materials for filaments; drawings of devices for producing and testing filaments; notes, drawings, and calculations about generators; notes by Edison on gas use in San Francisco; and drawings of arc lamps. There are also notes on batteries made and tested, notes on carbon button tests, and notes and drawings of telephones. The book contains 274 numbered pages.

Blank pages not filmed: 240-241, 258-261, 270-273.

Missing page numbers: 264-265, 268-269.

M01

1/2

$\begin{array}{r} 552 \\ 45 \\ \hline 2760 \\ 2208 \\ \hline 24840 \end{array}$

7500

---

(1) Gas Nov 28 1878

TAE

Sautrian uses 500,000,000 per year

if this was burned in burners

consuming 5 feet per hour

10 hours per day then

1 burner 20 days per 1000

or 500 burners 20 days.

1,000,000 feet would supply 1000

burners, or 500 000 jets would

burn up the entire [illegible] in

20 days, or 250 000 in 40

125 000 in 80. 62 500 in 160,

31,250 burners in 320 days,

[illegible] I think there is 40,000

burners in use,

~~500~~ 5) 1500,000 day

6) 300,000

50

200,000

300 100,000

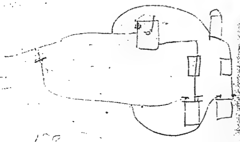
100

M01

$\frac{1}{2}$

12

552	
45	
2760	
2208	
24840	



12

7

150	
5	
3750	
3750	
7500	

Cooks Nov 28 1878

TAE

Sawtman uses 500,000,000 per year

if this was burned in burners

Consuming 5 feet per hour, ~~ea~~

10 hours per day

1 burner

burner in use

~~10~~ 5) 1500,00

6) 300,000

50

2 5000 100,000

100

2

15)188
128 8/15
60
720
32
752

15)480
32

2 3

Nov 28. 1878.

10000)1500000.
150,000.
9
1,350,000

165000
485000

170.000,
Tar

10

200 100 Ton 1 hour
50 2
25 4
12½ 8

25

500 10 stations 5 tons ...

170 tons.
5
850
80
1

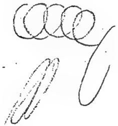
170
4
680.

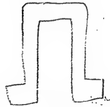
9)500 000.000
56,666

5 100
56 56000
9
514

Nov 28. 1878

TAE



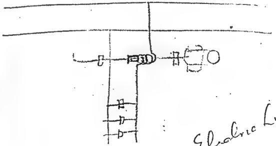


9 burners

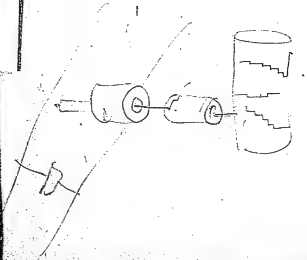
$1\frac{1}{2}$ 3

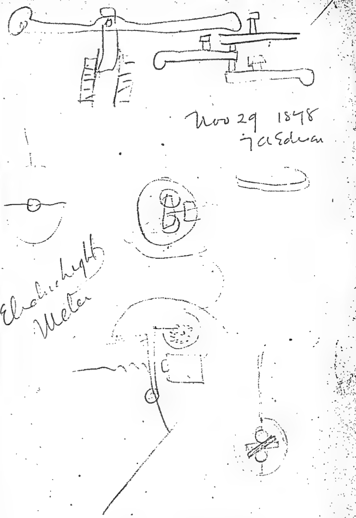
120

Nov 30 1878
TAEdison



Electric Light Meter





Nov 29 1878
T A Edison

Electric light
Meter

Nov 29, '8

see Pat. 242,901 & Pat. 222,112 W.J.H

Nov 29, 78

T A Edison

See Pat. 242,901 & Pat. 222,112
W.J.H

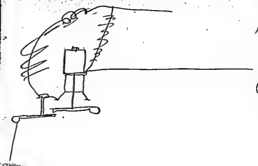
12

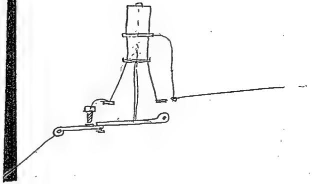
13

NOV 29 78

T.A.E

Chas Batchelor

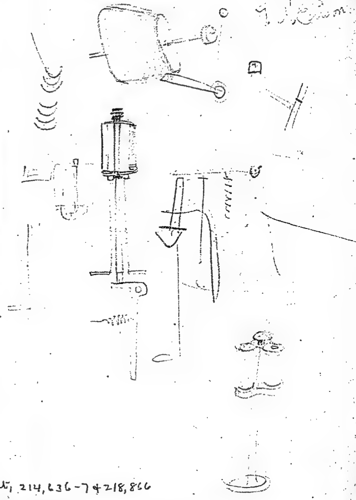




100.

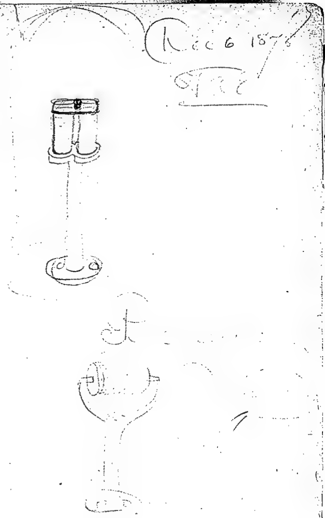
1	1
2	50
4	25
8	$12\frac{1}{2}$
16	$6\frac{1}{4}$

Dec 6 1878.
7.30 am



Pat, 214,636-7 & 218,866

Dec 6 1878



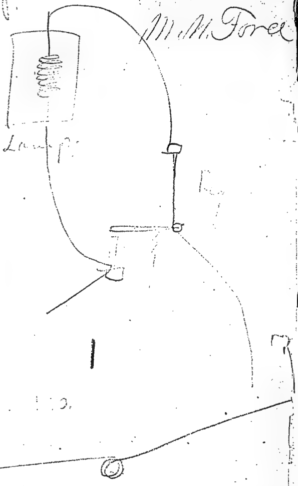
See Pat. 214,636-7 + 218,866

Electric Light

Dec 6 1878

M. N. Force

Made by Geo Carman



See Pats 214.636 – 214.637 – 218.866 N.J.H.

24

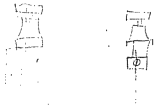
Electric Light

Dec 7 1878

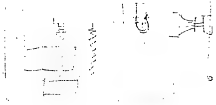
Chas Batchelor

27

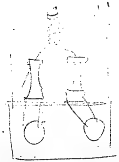
Made by Geo Jackson



2



2

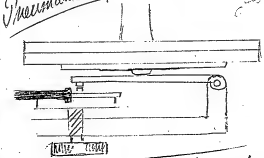


See Pats 214,636 - 214,637 - 218,866 N.J.H.

Electric Light — Dec 9th 1878

Pneumatic Regulator

Chas Batchelor
John Ott
TAE



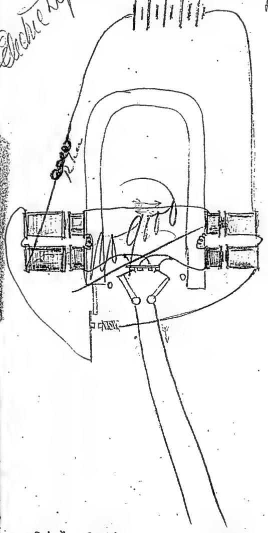
Shorten the Chamber & put lever in place of Spring

See Pat's 214.636 – 214.637 – 218.866 W.J.H.

Electric Light

Dec 15 1876

TAE



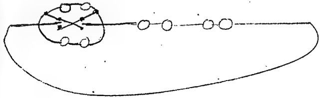
see Pat-218,166 W.J.H

Dec 15 1878

Fork Magnets

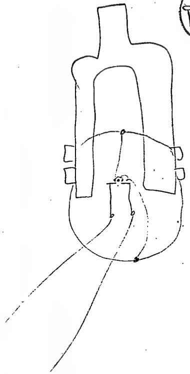
Chas Batchelor

TAE



See Pat. 218,166 W.J.H.

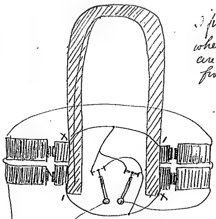
DEC 15 1878



see Pat. 218,166 W.J.H.

Electric Light

Dec 15th 1878 3
Chas Batchelor
TAE



I find most current when induction magnet are connected together from X to X & 1 to 1

We got a very slight current owing to the magnets not having play enough they never got far enough away from the field of force

We want more Amplitude of vib. in fork

[See Par 219166 WJH

With plain fork with q and OTH
we get on end of fork

24½ inches of fork	vibration	·10 of inch
17 " " "		·06 —
11		·04 of inch

With weights when tuned up.

24½ inches	vibration	·14 of inch
17 —	—	·07
11 —	—	·045

see Cat 218,166 W.J.H

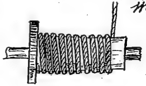
Electric Light?

Dec 17 1878
Chas Batchelor

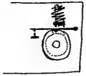
Train of Gears
generator turns 600
Weight to fall 10 feet
size of drum about 3.85
in order to make 10 feet
drop in 10 turns

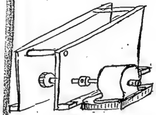
Pin on drum to connect
circuit and on turning
ten times opens again

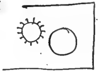
Large handle for winding
Weight up again

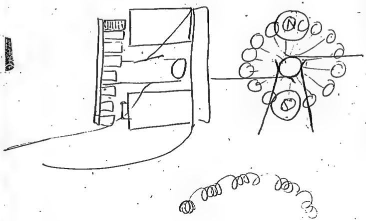


TAE









TM

33

Electric Light

Dec 18 1878

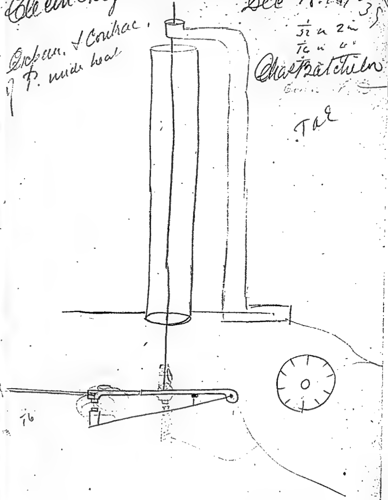
35

Expan. & Contrac. of P. under heat

$\frac{1}{32}$ in 2 in
$\frac{1}{16}$ " 4 "

Chas Batchelor

TAE

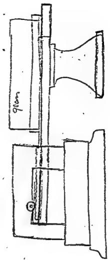


Electric Light

Dec 1st 1878

Chas Batchelor

+ or



$\frac{9}{96} = \frac{2.25}{24}$

$\frac{3}{32}$

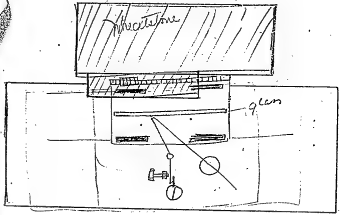
Instrument for recording [illegible] of $\frac{1}{32}$ then 3 turns for $\frac{3}{32}$

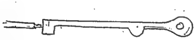
" 24 " $2\frac{1}{4}$ for $\frac{3}{32}$

3
spiral

Chas Batchelor
John Ott

TAE

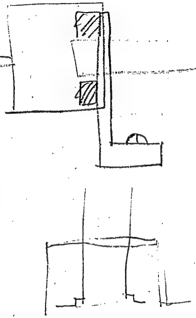




Magneto Electric Machines Dec 26 1878

Chas Batchelor

TAE



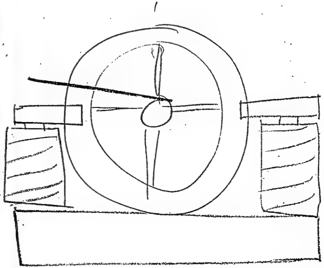
2/1

2/1

Magneto Electric Machine Dec 26th 1878 14

Chas Batchelor

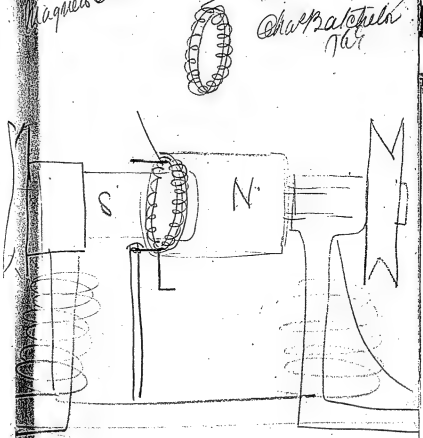
TAE



Magnets Electric Machine

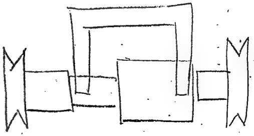
Dec 26th 1878

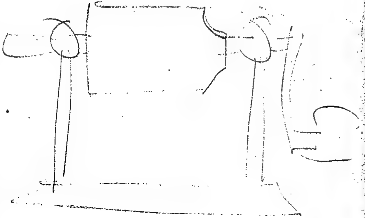
Chas Batchelor
T.A.E.



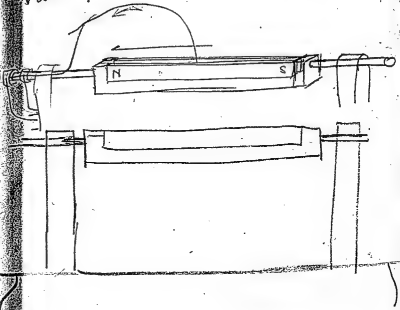
57

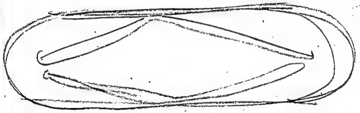
Tar

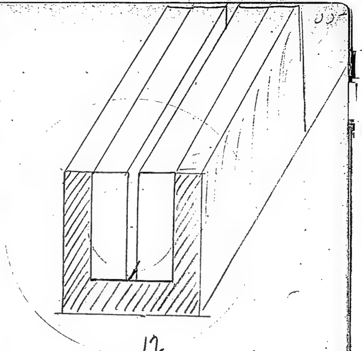




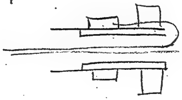
Faraday Disk FAE

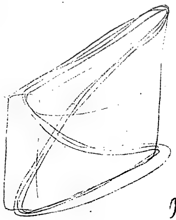




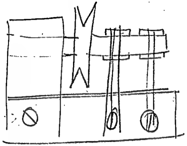


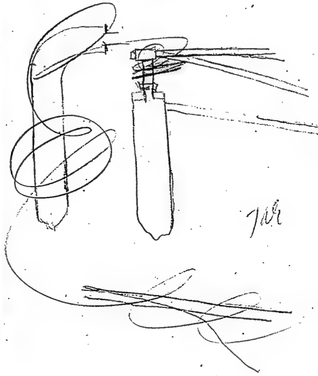
1 piece 12
1 " . 4

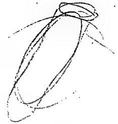




TAE







Johnson Matthey

Iridium 17·4·2 per oz.
Rhodium 30' 6d pr oz

Aluminium did not melt in the H flame and in the O.H seemed only to oxydize without melting. Came up to incandescence without melting. When the blast of O was brought in contact it melted

Magnesium
Oxidises too easily

Manganese.
Cannot tell anything about it.

Palladium does not melt.

Cobalt. Little seems to stay at white heat. Melts when oxygizing at white heat. The Breaks in pieces under hammer.

Nickel changes very little at white heat except to oxydize. Does not melt light brilliant. Can be pounded though cracks appear from non annealing. (as infusible as Pt) Greatest difficulty in melting it seemed to melt at about the same temperature as Pt. E
See page 66

Cerium ~~does~~ seems not changes Slightly fused. The fusion probably due to impurities of silica. E.

Iron went immediately

Silicon seems to volatilize at [illegible] when a certain temp- [illegible]

Silicate of nickel. ~~Does~~ Nickel & Silicon placed together in flame O & H. Melted but not very readily. The mass was magnetic.

Rutile oxide of Titanium fused. Good conductor very [illegible] [illegible] when [illegible] [illegible] ~~[illegible]~~ 17 Ohms

See Pat. 219,628

Nickel

The button was extremely hard and green when broken

Resistance of a wire 1 ft long 1 mil in diameter 75.178 Matthiessen

Resistance of wire 1 Metre long 1 mm in diam. 1.078 Nickel annealed. This is about 1/3 greater than Pt.

Wright Vol. 13 Amer. Jour. Sci. P. 52 obtained a thin film in a tube which in transmitted light was gray or brownish gray. The removal of O was not complete

Nickel

The button under the microscope was insulated by what seemed like lime. no metallic color be discovered

Lasimeter No. 1.
Patrick & Carter

29	R	100
25	L	50
20	L	25
15	L	0
10	L	100
5	L	170
10		Off

~~10~~ 5	R	270
10	R	220
15	R	280
20	R	250
25		200
30		1.00
35		125
40		150
45		Off scale

70

80 L — Off

35 L — Off

~~Stuck at stay~~
shaken the

0 Pt O

25 — Off

20 — Off

15 End

10 — End

5 — End

6 — End

71

95 — L — [illegible]

90 — 125

85 — 125

80 — 0

Changing

68 + 125

62 + 180

50 R — 170

45 L — 150

40 L — 140

35 L — 140

30 L — 140

25 L — 140

20 L — 135

15 L — 130

10 L — 130

5 L — 120

0 L — 120

95 L — 115

90 L — 115

85 L — 115

80 L — 110

75 L — 105

70 L — 100

65 L — 50

60 L — 35

50 L + 45

50 L	+140
45 L	+230
40 L off	+360
45 R	+360
50 R	+355 5
55 R	+345 10
60 R	+345 0
65 R	+340 5
~~70 R~~	+337 8
75 R	+335 2
80 R	335 0

85 R	335 0
90 R	335 0
95 R	335 0
0	331
5	335 0
10 R	+300 35
15 R	+285 15
20 R	+250 35
25 R	+208 50
30 R	170 30

76 Nov 1.

35 R	+	130
40 R	+	45
45 R	R	— 45
50 R		— 140
55 R		— 225
60 R		— 300

77

Rasimeter made in shop 50 Divisions

~~40 R~~ 30 turns

30 R	— 150
25 L	— 132
20 L	— 100
15 L	— 75
10 L	— 55
5 L	— 40
0 L	— 30
45 L	
40 L	— 30
	— 20

35 L — 5
30 L + 5
25 L + 40
20 L + 80
15 L + 130
10 L + 200
5 L + 305
0 L
off

45

0	L	off
5	R	"
10	R	"
15	R	"
20	R	"
25	off	
30	off	
35	off	
40	off	
45	360	
50	+ 335	
~~0~~		
5	+ 330	
10	295	
15	235	

20 R 145

25 R 130

30 R – 175

32 – 250

33 – 275

34 – 325

Life same 41

#7 ½ L just off the scale

20 R

25

30

15 with next shot off beams

---

45 350

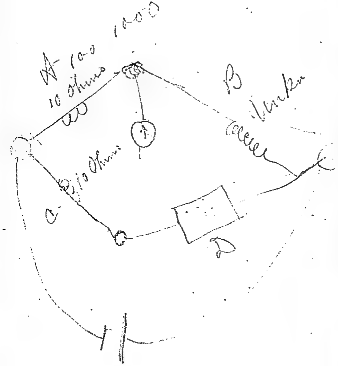
0 270

5

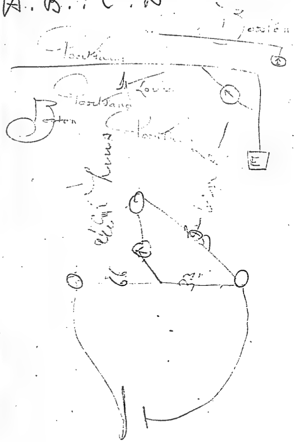
10 150

15 R 100

25 -- 30



A : B :: C : D



8

Nr. 1.

~~One the~~ Ohm turn
plug in the screw.

from 19 Ohms to
1/4 ohm ... battery

No. 2 10 Ohms resistance

75	R	320	
90	L	290	30
85	L	+235	45
			45
80	L	170	
			30
70	L	60	
			55
65	L	5	
			65
60		−60	
			5
55		−155	
			95
50		−250	
			85
45		−335	

the O f

50	R	−320	
55	R	−250	70
60	R	−190	60
65	R	−120	70
70	R	−70	50
75	R	−15	55
80	R	+42	57
85	R	+97	55
90	R	+142	55
95	R	+210	66
0		+265	55
5		+320	

No. 1 New carbons 7

11 Ohms to 1 Ohm

tested on one Ohm and found that the slightest change of the screw would throw the spot off the scale.

very little play in screw and none when sensitive at ninth of Ohm

About 80 divisions play when the R = 4 Ohms and Galva. doubly shunted.

No. 2

80 divisions play 9 Ohms
Galvanometer Shunted

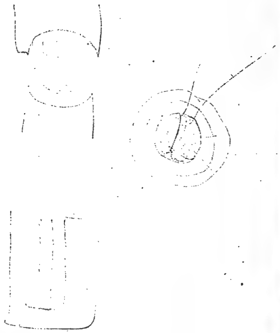
from 17 Ohms to .7 Ohm
60 divisions at 1 Ohm

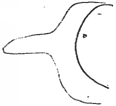
Instrument made
has very little play
[illegible] sensitive

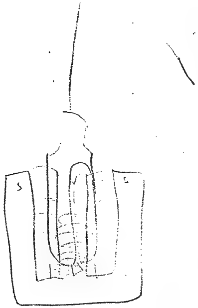
No 3 no play
very good

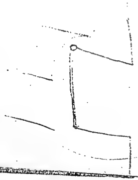
Tried again with a
shunt on Gal and found
80 divisions back lash

Pages 90 to 97 incl. "Dynamo Sketches."

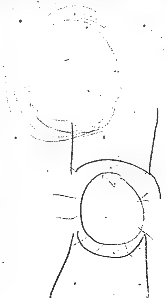


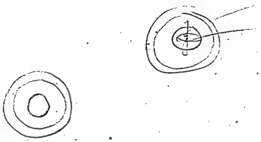




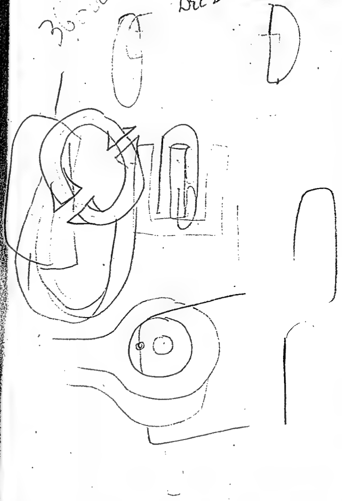


ohr

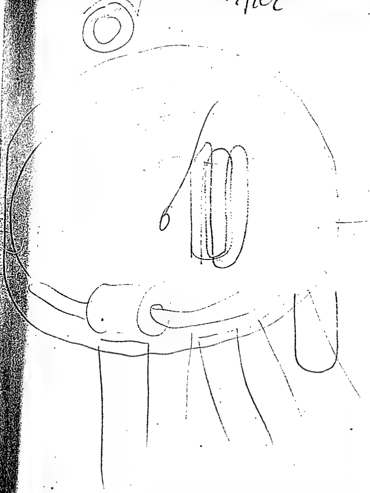




30000. Dec 25 [redacted] 1898



TAE



Coulomb per gramme

Th-Ch per gram .198547

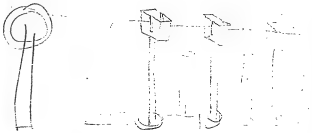
Log $\bar{1}.297798$

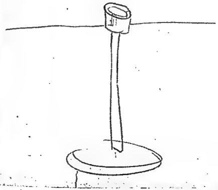
7000 log 3.845098

3.142899

TAG 101

Wire drawing, While heating Wire. Page 101.





11.

11

8

8

24
8
192

60

60

56

60

192)33360 (16
192
1440

24 56

$$\frac{8 \times \cancel{24} \times 3\cancel{4}}{\cancel{60} \times \cancel{02}}$$

10 13

240
24
160

$\frac{8}{13}$

8

36 on shaft

42

0

$\frac{24}{60}$

$$\frac{36 \times 30 \times 24}{11 \times 42 \times 52 \times 60}$$

180
8
1360

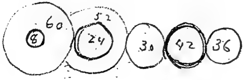
$$\frac{\cancel{36} \times 30 \times 8}{11 \times \cancel{42}}$$

6

7

$\frac{1360}{77}$

77)1360 (17.2
77
590
539
210



~~8 24~~

8 X 24 X 36

~~0~~ 8 X ~~60~~ X 52

~~24~~ X ~~36~~

6 3   6 3

9) 160 (17
9
70

~~44~~ 7   13   ~~10~~   5

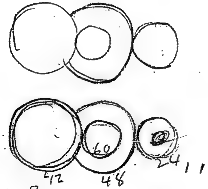
~~42~~ X ~~52~~ X ~~60~~   ~~300~~

36 X ~~20~~ X 24 X ~~8~~

~~6~~   3   ~~4~~

35
13
105
35
24) 455 (18
24
215
193
220

8 X 36
288



8

36

8

$$\begin{array}{r} 36 \\ 60\overline{)396} \\ 66 \end{array}$$

8

$$\frac{8}{2}$$

33 48

11

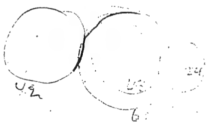
24 48 60 42

$$\frac{8 \times \cancel{60} \times \cancel{42}}{\cancel{60} \times \cancel{30}}$$

13

10

$$\begin{array}{r} 13 \\ 8 \\ \hline 104 \end{array}$$



No. 25 wire

2.72 Ohms

132 turns

$$132\,)\,2.72\,(\,.02$$

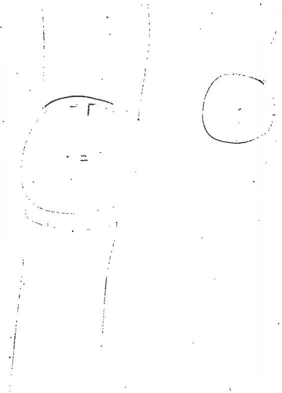
$$\begin{array}{r} 2.72 \\ \underline{2.621} \\ 80 \end{array}$$

$$\begin{array}{r} 500 \\ \underline{272} \\ 2\,)\,\underline{228} \\ 114 \end{array}$$

$$\begin{array}{r} 132 \\ \underline{114} \\ 18 \end{array}$$

$$\begin{array}{r} 17 \\ \underline{12} \\ 132 \end{array}$$

$$\begin{array}{r} 12 \\ \underline{8} \\ 96 \end{array}$$



100
12

1047
3
.131
1100
131
.131
144.100

1100

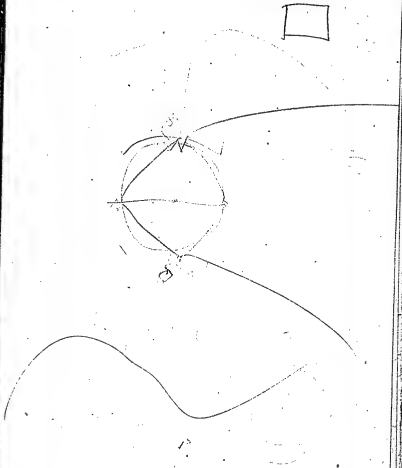
~~[illegible]~~

288 inches

28.8
14.4
7.2

200°
62°
138°

1380°
2760
~~1380~~
5520°



+ 20 Ohms $2\frac{1}{2}$ No 30
10 Ohms
10 Ohms
5. Ohms 2 spools No 25
2 at 2 Ohms 1 spool No 2
2 Ohms
1 Ohm 1 spool No 20
.5
.2
.2
.1

No. 30 Wire

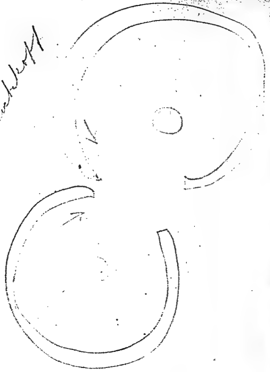
3 spools 20 Ohms

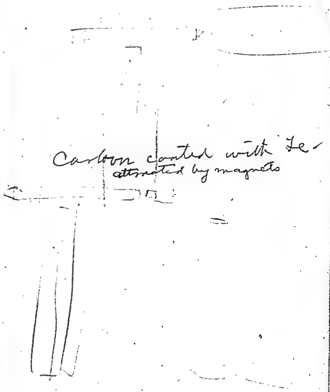
~~No. 24~~

5 Ohms 20

2 Ohm 1 spool No 23

Curved Jablochkoff

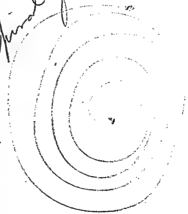




Carbon coated with Fe -
attracted by magnets

TAE

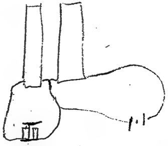
Spiral Jablochkoff:



March 12

The discharge from a magnet measured

A sounder was placed thus

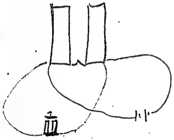


A ~~double~~ click could be heard when the current was taken off

TAE

2^end method

TAE



Double clicks could be heard when current taken off

2nd method

A duplex point was used to break the main circuit and the discharge thrown through the sounder

Results when no armature was on the magnet the discharge was very stronger ~~and~~ sharper and of shorter

124

ter duration than when the armature was on.

125

Pages 125 to 152 incl. "No importance."

For coses 4.03 Diam 90 inch long
677 ft of No 8 wire =
" 11 Birm. gauge
= 0.45 ohms

314
5375
942
1570
16662
6.
99972

403
314
1612
404
1209
12.6552
90
1139.50

128 90000 7.03
896
400
256
144

1490000 643
84
60
40

1265
703
3795

643
314
2572
643
741929

8855
889295

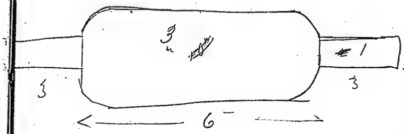
12) 20.19.02 = 168.
81
99
30

1500 6770 = .45 4912
7700

1265
643
3795
5060
7590
12) 81339.5 = 677 / 15000
93
93
1354
146

Lbs.

2
2
2
2
2
2
2
2
2
2
2
2
2
2
2
4
2
4


3
1
3
3
6

63 m 10 sec 10

1 lb at 10 inches

678
5
3390

10
3.14
12 | 31.4
2.6

381
831
381
1143
11711

1/2 lbs

63.
6
378.
5
1890

127.
3
381

30

20
3.14
6.28.
2
12.56

.256

3.14
40
12 | 125.6
10.4.5
3
31.2

20 inches

40 inches

20

12 ⟌60

5

~~120~~

10 feet

3

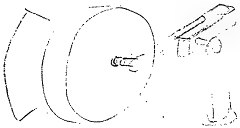
30 foot lbs

381

30

10,430

TAK



20 inches radius
40 inches diametre

40
3.14

$\frac{\cancel{40}^{10} \times 3.14 \times 3 \times 381}{\cancel{12}\ \cancel{4}}$

~~381~~
~~3.14~~

381
3.14
1524
381
1043
10,963.4

10,963.

Batch 10.963 ft. lbs.
20 seconds Test

Francis 16.046
10 Seconds 15.225

Martin 14.100. fd
20 Sec -

Geo Carman
14.106 ft lbs
20 Sec

Albert Swanson 17.191
15.750

Times 15.759 14445

97
6
58 2

2 91
3 X 18.5 X 2 X 3.14 X 582
12
4

291
3
873.
18.5
4365
6904
873
16,070,5

18.5
2
37.0
3
12 | 111.
9 1/4

18.5
2

9 1/5
3
27.75
.97
19425
24975
2691.75
6
16.146

140

5 . 1/2

171
5
855
855
9405
47003
14.100

28.15
171
2815
19705
2815
4813.65

4.1.1.5
1.1.1.7
1.8.9
4618.70
4697

11·25 Radius, Stan 22·50

Rev. 171

Weight 5 20 sec

22·50
12/67.5
5·63

$5^{lb} \times 5.5^{ft} = 27.5^{ft\,lbs} \times 171 =$

4697 × 3 = 14.091

$5^{lb} \times 5.63^{ft} = 28.15 \times 171$

4813 × 3 = 14.439

Geo Cannan

Weight 5

Revolution 171

Radius 11 = diam 22

5.5

22
3
7/66
5.5
5
27.5
171
275
1925
275
4702.5
3
14106

Swanson

Rev. 210

Height 5

Radius ~~[illegible]~~ - ~~19~~ 20

20
3
14 | 60

~~19~~
~~3~~
~~14 | 57~~

4.75

3
210
1050
5
5250
3
15750

Kruesi

191 Rev.

11 Radus 22 Diam

5 ft.

5.5	22
191	7/66
55	3.5
495	5
55	27.5
1050	191
5	275
5250	2475
3	275
15750	5252.5
	3
	15757

Rhus

21.4
9 m Rasins - 18 Dram
5 h

3
154
4.5
21.4
8.5.6
1.07
9.6.3
.5
48.1.5
3
14.4.4.5

Swanoos

Weight 5

Rev. 191

Radius 12 = Diam 24

3

10 | 7 2

1 4 6

19

11 4 6

5

5 7 3 0

3

17.1 9 1

Weight

Rev. 203

Radius 10 — 20

5

$$\begin{array}{r} 2 \\ 10 \overline{) 60} \\ 5 \\ \hline 203 \\ 1015 \\ 5 \\ \hline 5075 \\ 3 \\ \hline 15225 \end{array}$$

154

This battery has now been ~~shortcircuit~~ put on 100 ohms 13 hours out of 48 hours —
We now connected to Bergmann bell on 100 ohms and

May 11 11 AM worked well
May 11 6 PM worked OK
May 12 7 am worked well
" " 1 PM worked ok
" " 8 PM All right
13 8 am all right
13 6 pm OK

9.30

May 9th 1879 155

Call Battery

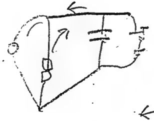
Chas Batchelor
M. N. Force

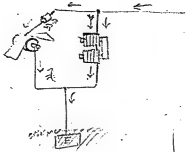
Tests on 100 ohms,
10 Couple Leclanche — Galv. Shunted

Put on	Deflec.	Taken off	Deflec	Total time on	Off
11 AM	67	12 n	65	1 hour	
1-30 PM	67	3.10	60	2-40	1-30
4 PM	65	7'50	50	6-30	.50
10 20 PM	53	11 PM	49	7.10	2.30
8-30 am	50	10 AM	35	8.40	
11 AM	41	12 n	32	9	
12-30 PM	35	1.50	30	11,	
2.25 PM	33	3.35	26	12	
10.15 AM	42	11-15	27	13	

See other side

116





117

Bishey May 10th 1879 M. N. Force

Call Battery No 2.

Tests on 100 Ohms

10 Couple Leclanche Gasshunter ½ Carbon ½ Hyperoxide Mg

Put on	Deflec	Taken Off	Deflec	Total time	
2.25 P.M	57	2.35	50	7 m	1 hour
3.35	32	3.45	45	0-10	1
4.45	50	4.55	43	-10	17
10.3 AM	55	10.13	36	=10	3
1 PM	47	1 10	34	<10	76
13th May 5 p.m.	41	9 PM	15	4.00	
14th May 12 noon	rings bell	through	200	ohms	OK

Batteries

May 15th 1899

No 3

100 ohms resistance always

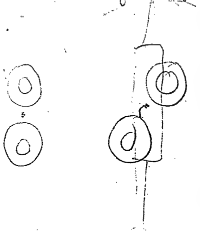
13 couples Zinc + Carbon

layer of NH_4HCl: $\frac{1}{16}$ thick

2 thicknesses of blotting paper saturated with NH_4HCl

Time	Date	Deflec	[illegible]	Total time on	[illegible]	Remarks
2.33	15th may	68°	56			
3 ~~55~~		63	54			
4 25	—	58 —	— —	—	— — —	[illegible]
6 P.M.	rings bell	perfectly	through	200	ohms	(Batteries)
[illegible]	"	"				
[illegible]	"	"	"	[illegible]	"	G.E.C
7.30 A.M	16 may	" "	"	400	"	G.E.C
[illegible] "				400		M. N. F.
11.30 P.M		weak	— — —	400	"	G.E.C
1 30 A.M	17th will	not ring	through	400	"	G.E.C
1.30 "	very	good	on	300	"	— —
[illegible] "	"	"	"	800	"	" " "
[illegible] "	rings	through		400		
[illegible]	"	—	"	400		
[illegible]	"	"		400		—
[illegible] P.M	"	"		400		

See page 175



Batteries No 4

10 [illegible] with [illegible] of [illegible] solution of [illegible] about 1/32 in thick ~~on~~ [illegible] 6 sheets blotting paper [illegible] in [illegible]

Put on
10 PM rang bell through 200 ohms perfectly GEC
16 May
7 30 AM " " " 400 " GEC
2 PM rings bell perfectly Through 400 ~~Ohms~~ M.N.F.
4 30 " " weakly " 400 ohms GEC
17th May
1.5 AM " very weak " 400 " GEC
3.45 " " " " " 400 " " "
6 " rang bell through 400 " "
8 " " " " 400 " "
10 " " " " 400
5 " " " " 400
18th May 4 PM. OK on 400 ohms.

See page 179.

G.E.C.

Battery No 5 May 17-79

11 Cups Zinc & Carbon with 6 sheets
Blotting Paper soaked in Saturated Solution
Muriate Ammonia [illegible] [illegible] square
[illegible]

[illegible]

4.20 AM [illegible]
[illegible] [illegible] Galvanometer
[illegible] not strong — G.E.C.
[illegible] a [illegible] [illegible] 600 ohms [illegible]
[illegible]
10 AM " " " " CB
[illegible]

taken off 4.30 PM May 17 and ~~sent~~ taken to Bergmann & Co
N.Y. By T.A.E. & C.B.
Brought Back and
Put on 20th at 5.30 PM.
[illegible] [illegible] 1840 [illegible] 20th.

G.E.C.

No 6 Battery May 17 79 7

Eleven Discs Carbon & Zinc in to [illegible] paper Soaked in Sulphuric acid 1 part to 12

GSC

ok

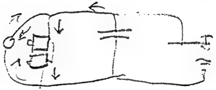
5.30 PM [illegible] 200 Ohms. GEC

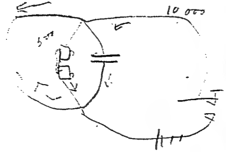
May 18 4 PM OK on 400 ohms — GEC.—

May 19 12 PM [illegible] GEC

" 23 Run on 100 Ohms after standing open for 4 days and will not ring Bell

C E Carman





Telephone May 17 1879

Chas Batchelor

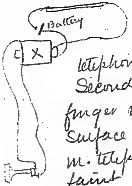
Made a button for transmitting tal of Sulphide of Copper.

It was just about one half as loud as our regular button

Its articulation was very perfect

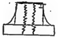
Its best talking was done when it measured 9 ohms resistance

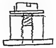
A piece of Sulphide of Copper measuring 37 ohms was put in primary circuit of coil X, and telephone receiver connected with secondary. Scratching with finger nail or knocking on surface of Sulphide can be heard in telephone but exceedingly faint.



Domestic
Domestic

Do





Battery 3

May 18th 4 pm. rings perfectly on 300 ohms
May 19th put on 100 ohms and closed every
hour 752 times at 5.30 p m

taken off at 6 and put on again
7 [illegible]

[illegible]

having rung the bell 5750 times

[illegible] 300 [illegible]
[illegible] through [illegible]
started 7 [illegible] May 2[illegible] 1899
[illegible] Ohms Resistance

[illegible] 12 [illegible]

[illegible] commenced at [illegible]
50 then taken off [illegible] 7 pm

May 27th 9 am put on bell but it would
not work it

- 198
145

3000.

$4\frac{1}{2}$

3

30

300

3 16.

Mac 3/4.

1	Mac 1/2 – LW $\frac{1}{4}$	– 30 lamps		16
2	$\frac{1}{4}$	– $\frac{1}{8}$	60	8
3	$\frac{1}{4}$	– .06	120	4
4	.12½			
4	06	03	240	2
5	03	01½	480	1
6	01½	07½	960	½

continued from page 163

Battery No 4 May 1916

5.30 PM Put on block [illegible] and [illegible] connected with [illegible] in shop [illegible] to ring 352 times per hour through 100 ohms — taken off [illegible] 5 minutes

[illegible] PM May 19th
[illegible] through 300 ohms

May 27 8.30 a.m. put on bell ringing through 100 ohms by shaft

May 20 1879

Battery is 7 [illegible] G E Cannon

11 Ohio [illegible] 5 [illegible]

[illegible] 3 parts [illegible] 1 30 PM

[illegible] 752 lines per hour

[illegible] through 700 [illegible] resistance

[illegible]

Taken off 3,30 PM for ½ hour and internal resistance [illegible] 20 Ohms put on at 4 P.M. [illegible] PM) [illegible]

May 21

[illegible] 7 AM

run till 10 PM — May 22nd 1879

started 7 AM — on 100 Ohms resistance.

run till 11 PM See Page 185

Rahway [illegible] 2 - [illegible] 163

May 2 5th 1899

[illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

[illegible] Soaked in Sal Soda

3 β to C 4/4 water

Pulino [illegible] [illegible]

[illegible] [illegible]

[illegible] Carman

from Page 181 G E Carman

Battery No 7 — May 23rd 1879

Has run 21 hours 752 Pr hour 15.792 ltrs G E Carman

Started on 100 Ohms resistance at 9 A.M. Chas Batchelor

run on 400 Ohms =

taken off 11 PM having run 14 hours total

running time — — — — 36 hours

run May 24 — — — — 9 hours

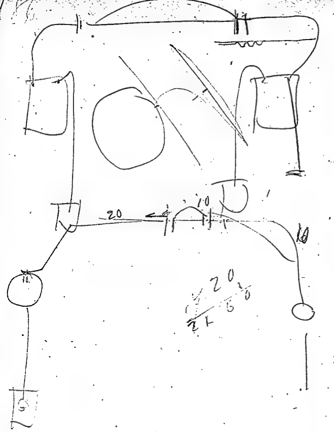
45 hours

Making 752 strokes pr hour makes 33840 strokes

Saturday 5 P.M.

May 26 Monday Put on at 9 A.M.

186



May 29th 1879

Battery no 9 Chas Batchelor

9 couples: Carbon & Zinc
6 papers wet with Chl Ammon

Put on at 1 PM May 29 1879 and it rings through 100 ohms good but it wont through 200.

taken off 4 PM called 2150 times

Total time Made	on	off	calls	total calls
3 hours				2150

Bat. No 90 Batchelor

Put on 4 pm 29 May 1879

rings through 100 ohms

 Battery G S Cannan

No 11 May 31st 1879.

9 couples Carbon & Zincs with
Six Layers Paper in Sol Sal Ammon
and water Equal parts
Zinc each Smaller than Carbon plate
run through Ion Ohms resistance

[illegible] 2" 10 ## rings now only on
short circuit

 G E Carman

No 12 Battery May 31 1879

9 Larges carbon & zinc taken from No 5 and cleaned set up and rings through 300 Ohms — formerly rang through 600 " weakly

June 2nd 10 AM rings weakly on 200 ohms

G E Carman

No 13 Battery May 31st 1879.

6 cells Carbon & Zinc strips in solution Sal ammoniac and water equal parts rings through 256 ohms resistance

June 2nd wont ring owing to corrosion of copper at point of contact of wires

Make another —

— S L Griffin

Battery No 14   May 21 79

Plates Zinc & Carbon

Carbon soaked 14 hours in Electropoin then washed and boiled in parafine

Run through 500 ohms resistance at 3.30 PM through 400 at 4.30 PM

George

Make a battery of Carbon and Zinc with 6 sheets of paper between. (Amalg.)

4 Sheets next the carbon to be soaked in solution of 1 part ordinary bichromate Solution and 1½ parts water

2 Sheets next the Zinc soaked in weak solution of Sulphuric acid & water

---

Make a battery of Carbon + Zinc and between them, put a layer $\frac{1}{32}$ thick of Sulphate of Mercury on the carbon Then put 2 sheets paper soaked in Solution SO_3 (12-1)

Make bottle battery 10 cells like other one but weak solution of Bichromate in Amalgamate Zinc

---

Make bottle battery 10 cells like above but weak solution $SO_3 + H_2O$
Amalg Zinc

Make battery of 12 bottles of Zinc + ~~Carbon~~ Copper (no amalgamation) fill bottles with solution of Alum (concentrated)

Make up Sal Amm bottle battery again making good connec. & paraffining them

---

Make ~~bottle~~ batt. of Amal Zinc an carbon in Bichrom. + H_2O 12+1 and let Zinc stand in Hg at bottom of jar

---

Battery No 15 June 2d 1879

9 cells Carbon & Lead (Cunning).
(6 sheets paper 4 soaked in Elec^n /
Water 1½ and 2 soaked in SO_3 very
weak

10 AM Ringing alarm through 100 ohms but
after five minutes it went [illegible] on
short circuit

June 2d 1879

Battery 16

16 Bottles containing amal. Zincs and carbons in Solution of Bichromate 1 to 6 H_2O

10 AM June 2d 1879 rings through 800 ohms.
10 am June 10 1879 rings through 125 ohms

Battery No 17 June 2 1879

10 Bottles Amalg Zinc and Carbon in Solution of $SO_3 + H_2O$ in prop. of 12-1

---

10 AM June 2 1879
rings through 500 ohms good

11 AM June 10 1879 300 ohms good
" "

Battery No 18 Chas Batchelor June 2-79

10 Bottles Amalg Zinc and carbon in Electropoion 1 Part water 12 with Mercury in Bottom of bottles

3pm June rings through 400 ohms good

Made	goes through	Date	
10 AM	June 10 corroded	played out carbons at connections	

Battery No 19 June 2 1879
Chas Batchelor

10 Bottles Zinc x Copper in Saturated Solution alum

[illegible]

3 pm. June 2.

Made	rings through	date		
	200 ohm	June 2	3pm	
June 9	1879 played out			

June 2 1879

Battery No 26

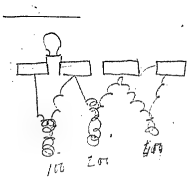
Chas Batchelor

Zinc & Carbon

No 6 [illegible] Sulph Mercury Zinc 2 sheets paper wet with So and [illegible] 12 to 1

Rings through 300 Ohms at 2 PM

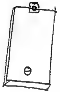
How long	rings through	on	
	300 ohms	15 ohm 2pm June 2	
6 hours	500	15 ohm 8pm "	
20 hours	400	10 ohm 10AM " 3	

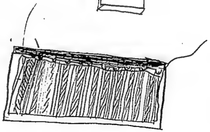


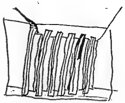
 Battery June 5th 1879

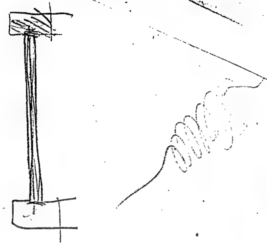
No 21. Same as no 20 6 made

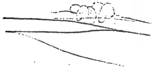
Ring through 600 Ohms











1/2 diameter

1/4 section

4 times length or convolutions

16 times resistance

1/100 16 times resistance

1/100

1/10

$23 worth of wire

~~[illegible]~~ takes 1/10 of H.P to run

it it . 0.05 a year

$7.00 a year

$$\begin{array}{r} \$7.00 \\ 2.30 \\ \hline \$9.30 \end{array}$$

36.5	1.5623
23.	1.3617
23.	1.3617
	4.1857
	.3010
	3 | 4.4867
	1.4956

2.7234

$a = \frac{15330}{2}$

~~$66~~ $31.2

Let x = cost of wire

And y = cost of H. P. [illegible] for magnet

$y = \frac{a}{x^2}$

$y + x =$

$yx^2 = a$

$\frac{a}{x^2} + x = \text{min}$

$y = \$36.5$

$x = \$23$

$a = 15330$

(x^{-2})

$-2a x^{-3} + 1 = 0$

$x^{-3} = \frac{1}{2a}$

$2a = x^3$

$x = 31.20$ min.

2cts. an hour

$$X = \cancel{\$}23$$

$$\begin{array}{r} 3.65 \\ 2 \\ \hline \$730 \end{array}$$

$$\log X^2 = 2.7234$$

$$\$73 = y \quad \log 2 = \underline{.3010}$$

$$3.0244$$

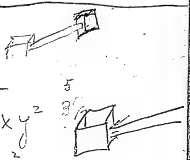
$$\begin{array}{r} 2.7234 \\ 1.8633 \\ \hline 4.5867 \end{array}$$

$$\begin{array}{r} 3.1244 \\ 1.8633 \\ \hline 4.8877 \\ 1.6292 \end{array}$$

~~$42.5 H. P at 2cts an hour. If ten magnets per H.P. will furnish power enough with the magnet of machine as once built $42.50 may be spent so as to bring 10% on a machine used ten hours a day.~~

x = length

y = Diameter



Mass of iron $a x y^2$

Cost iron $b x y^2$

Cost Cu. $c x y$

Efficiency Cu.

$$\begin{array}{r} 52 \\ 30 \\ \hline 1560 \end{array}$$

$$\begin{array}{r} 52 \\ 156 \\ \hline 364 \end{array}$$

$\sqrt{x}\ \sqrt{y} \quad a x y$

$(b x y^2 + c x y)$

The lamp

6 per H. P. July 8

1/2 ct an hour each for H. P. Cost including allowing for loss

cost and repairs of engine and boilers as delivered to Dynam machine

20 lights $100 dynamo
Gas 200
$150

$5
$5
$5
$15

1/2 ct a day

interest for capital

lamp. Each light must burn on a average 7 hours

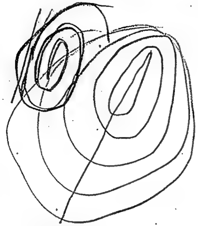
Suppose 1/2 Ohm machine 100 compared 1/2 Ohm

2 times the wire to make it equally efficient with same current

1/2 Ohm ma compare

with

If the wire the same current has



4 Ohms same wire

4000 turns
4000 Ohms
4000 4000 Ct
1 Current

4 Ohms
1

~~1.18~~
1.19 Bridge
1.116 Slide

$$\frac{9}{56)\,.7.0\,(.16}$$

56
340
336
4

~~[illegible]~~
magnets

24 hours a day

3.65 1ct an hour
24
1460.
730
8760 $876

1H. P on magnet
~~[illegible]~~ cost of magnet

$\log 2x^2 = 3.0244$
876 2.9425
3)5.9669
1.7889
.3617

$97.50

$97.50
1/2 Ohm
2 times the wire same current same no turns
just as effective
1/2 Expense

4 times the wire 2 times the no ~~turns~~ times the resis ~~[illegible]~~ the same resistance as at first
1/2 the current twice the strength
1/4 as expensive

~~2~~ Law

The economy of a magnet is directly proportional to the weight of Cu. on the magnet ~~if~~ the current be ~~arranged~~ ~~to~~ made to suit the resistance. For example a magnet of 1 Ohm consuming, ~~to~~ with 10 Webers of current on it, 4430 ft. lbs. of energy a minute and has strength of 10.

A magnet of ½ Ohm having the same no of convolutions, made by twice the wire, with the same

current on it, will have strength 10

Cost 2215 ft. lbs.

A magnet of two Ohms having twice the wire or twice the no. of convolutions will ~~be~~ ~~stronger~~ with half the current have strength 10

cost 2215 ft lbs

Therefore it is better to buy a large sized wire as less cotton is bought and more Cu with the money!

234

$a = xy$

\$23

$x^2 = a$

$x = y$

23.	1.3617
36.50	1.5623
	2.9240
	1.4620
	.1505
	1.6125

\$29 can be expended

\$41 at 2 cts an hour

1 H.P. at 1 cts

1.4620
.5005
1.9620

\$91.6

237

Data ~~the large~~ The wire on the ~~large~~ magnet cost \$23. If 1/10 of a H.P. ten hours a day are consumed on it, ~~he~~ how much can be expended in buying wire?

$x =$ cost of magnet

$y =$ cost of H.P. principalized

$y = \frac{a}{x}$ $x = \frac{a}{y}$

$x + y = \min$

$\frac{a}{y} + y = \min$

$-ay^{-2} + a = 0$

$-y^2 = a$

$x^2 = a$
$y^2 = a$ $x = y$

1809.25

1691

When the principal which will give interest enough to pay for the H.P. used, equals the cost of the wire then the maximum of economy will be obtained.

ten hours a day

1/10 H.P. at 1 ct. an hour $29 can be expended

1/10 at 2 cts

$41

1 H.P. $91.60

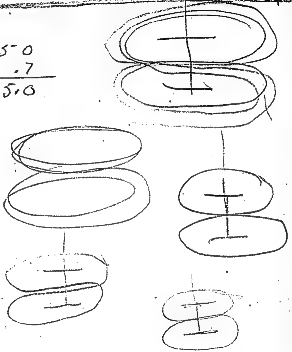
15.05
.8495

9 Ohms	3 times the cond
1 Ohm	~~1~~
1/2	1/1.47
1/4 together	1/2
1 Ohm	100 convo
1/2 Ohm	70.7 convo
1/4	50 convo
1/5	~~[illegible]~~

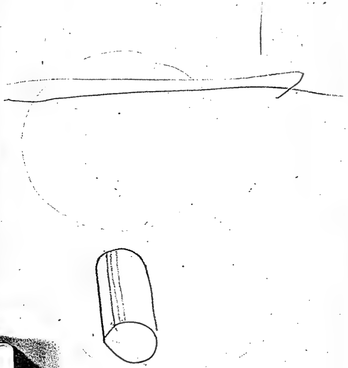
1/2 . . . .

1/2 . . .

15.0
.7
10.50



1/2 Ohm how ~~many~~ much wire to weigh the same as 1 Ohm



1905

$ 35.94 No 12 wire

1 Ohm 1 pound

1/2 Ohm 1 pound

No. 19 wire

1.09 Ohms in lbs
140 feet in Ohm

No. 18 .59 Ohms in lb.
" 116 feet in 1/2 Ohm

No 23 wire

No. 23 wire

8.7~~4~~ Ohms per lb.

60.5 feet per Ohm

No. 20 wire

2.27 Ohms per lb.

4 | 118.5 feet per Ohm

29.6 feet 1/4 Ohm

.25 44.3 1/2

400

.5 177200

.5

.25 141.3

6990

1505 3495

8495

1.5227

150 Volts

.9613

550 : 700 :: 150

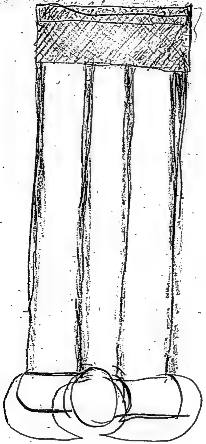
550 | 105 000

8.74

6.05

If an armature has 10 lbs. of Cu. on it and a resistance of 1 Ohm, with 100 convolutions

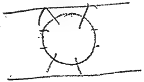
If 10 Ohms	316	Convolutions
5 Ohms	223	"
4 Ohms	200	"
2 "	141	"
1 "	100	"
1/2 "	71	
1/3 "	57.7	
1/4 "	50	
1/9 "	33	
1/16 "	25	
1/25 "	20	



How can I get

1   1,4   1. $\sqrt{2}$

$$\frac{\sqrt{2}}{2}$$



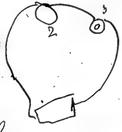
55) 10500 (190 Volts
55
500
495
50

~~550) 10500 (~~ [illegible]

248

$$\begin{array}{r} 190 \\ 71 \\ \hline 190 \\ 1330 \\ \hline 1349.0 \end{array}$$ Volts

1 Ohm coil
5 Ohms Trans
2 Ohms battery 1/10 Ohm



8 Ohm

Current changes

Change in current 7092
.2908

$\frac{1}{8} \times \frac{1}{80} = \frac{1}{640}$

$\frac{1}{8} \times \frac{1}{640} = \frac{1}{5120}$ 1954

249

2 Ohms 4312

$\frac{\cancel{2}}{9} \times \frac{1}{\cancel{810}} = \frac{1}{3645}$ 2700

$$\begin{array}{r} 405 \\ 9 \\ \hline 3645 \end{array}$$

3 Ohms

$\frac{3}{10} \times \frac{1}{1000} = \frac{1}{3333}$ 3000

333

4 Ohms

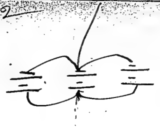
$\frac{\cancel{4}}{11} \times \frac{1}{\cancel{1210}} = \frac{1}{3327}$ 3000

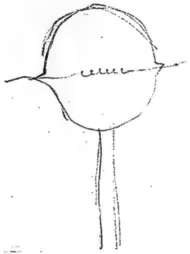
$$\begin{array}{r} 302.5 \\ 3025 \\ \hline 3327 \end{array}$$

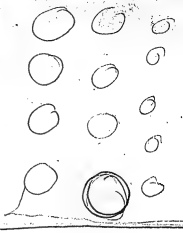
July 24th

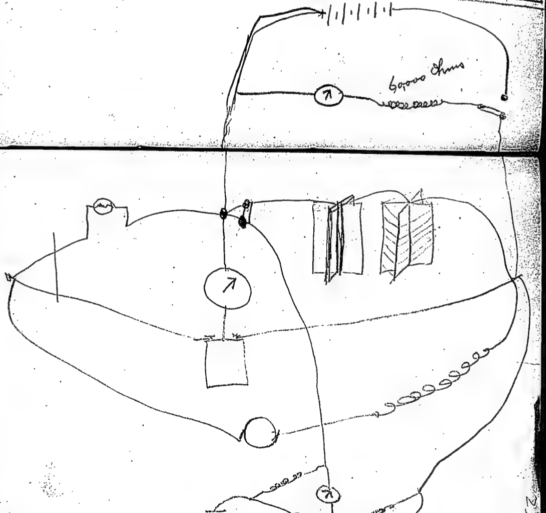
Whole line	456
without Receivers	320
Secondary & bell	161
Tertiary	350
Button (Chalk)	7700

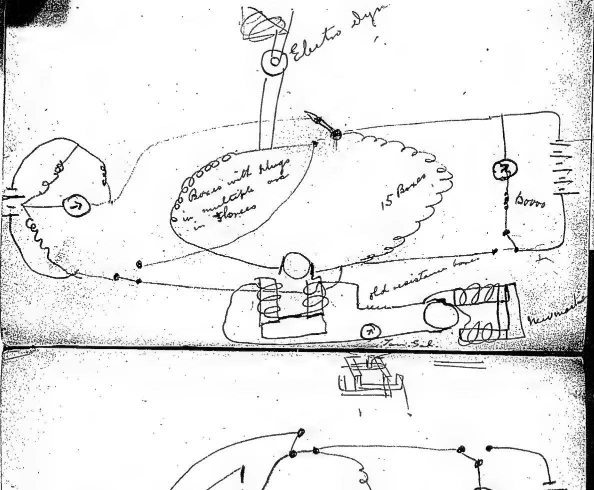
Secondary & Bell — 167

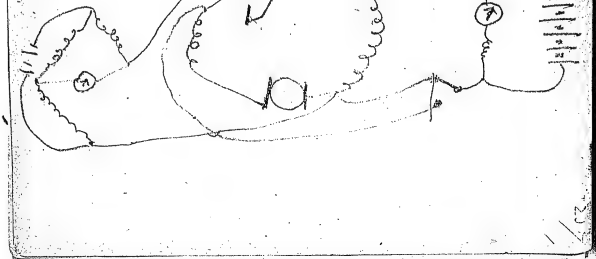




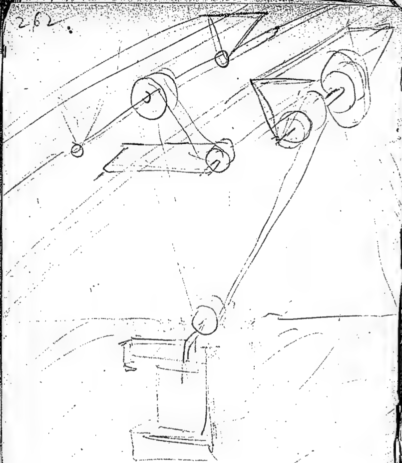



60000 ohms


Electro Dyn
Boxes with plugs
in multiple and
in series
15 Boxes
old resistance boxes
New machine

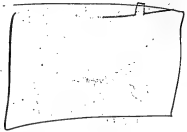


262



10

10000



1000000

100000

7) 160 22.857007

7) 80 11428

11.428

243) 4000 (1646

243

1570

1458

0120

72

1480 0.0001

1458

13) 750 (5769

65

100

91

90

78

120

117

30

19) 750 (39473

57

180

171

90

76

140

133

70

17) 750 (44117

68

70

68

20

17

30

17

130

1392 / 2652 20
2784

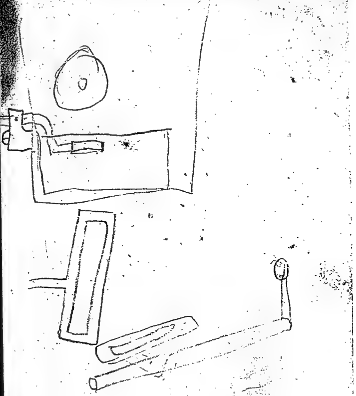
17/7 1½

15 35

26 1
21

325
314
1300
325
975
10.2050
6
6140
52
12240
30600

12 : 318240 = 2652
78
62



Menlo Park Notebook #2 [N-78-11-22]

This notebook covers the period November 1878-June 1879. Most of the entries are by Charles Batchelor and Francis Upton. There are also entries by Edison and John Kruesi. The name of Martin Force appears occasionally as a witness. Almost all of the material relates to experiments on electric lighting. Included are notes and drawings of spiral filaments; tests of filaments brought to incandescence with batteries and generators; notes, drawings, and calculations about generators; drawings of a MacCleod gauge; and notes by Edison on another inventor's arc light patent. There are also drawings of the telephone, notes on chalk and carbon buttons, and a memorandum by Edison on Frank McLaughlin's prospecting trip to the Chandiere River in Canada. The book contains 262 numbered pages.

Blank pages not filmed: 48-49, 112-115, 118-131, 136-137, 158-201, 206-224, 227, 230-262.

Missing page numbers: 225-226.

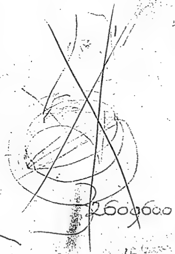
No 2. 12,
9,36
6,50
27,86

30,
27,86
2,14

16,
5
80,

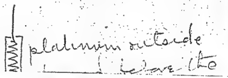
3.

4.



Nov 22 1878
T A Edison
Chas Batchelor

Pt spiral



Edison Lab

No. 2

12,
9,36
6,50
27,86

30,
27,86
2,14

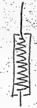
16,
5
80

3,

...ary 1, 189[illegible]

Nov 22 1878
T A Edison
Chas Batchelor

Pt spiral



platinum outside fused before the Embedded spiral

The platinum spiral was imbedded in plaster paris but this had so much Water that it cracked in using

Zircon should be used

+ spiral heated

Zircon is under pressure

Electric Light Dec 5 1878

Batchelor
To be made immediately & shown on Friday afternoon -

2 old style lamps double spiral square

1 Lamp (long spiral) about ~~20~~ 6 springs

2 Lamps new pattern,

Get some platina wire suit for springs

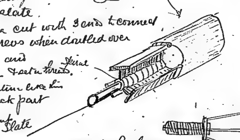
Electric Light   Dec 4th 1878

Chas Batchelor

Machine for filling spirals with chalk or other insulator

Spirals must be made with equal numbers of threads

1 Mandrel made as per drawing —



2 Through hinges back.

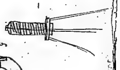
3 first put on a clamp like this 

4 then put on the slate.

5 then bottom platina cut with 3 ends to connect with the screws when doubled over

6 then put spiral on end Spiral throw down leaves & set in threads.

7 put an end in of platina like this with (thread in thick part



8 then put another clamp Slate like this 

9 then put a piece on Mandrel to keep the leaves together and the right distance from centre

10 Now fill with chalk

11 then put screws in your clamps

12 " take end off and throw back your clamps

13 Now fill with chalk the places where the leaves were

14 then screw together by the clamps till you have the right size

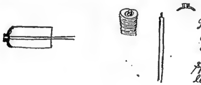
15 Now put in slate mandrel & heat up high.

16 screw in the platina rod & put collar below the bottom & take off top clamp & it is ready for mounting in the instrument

Electric Light

Dec 3rd 1878
Chas Batchelor

Mode of fastening the ends of spiral into end piece.



Platina rod is threaded on end and a shoulder cut on it

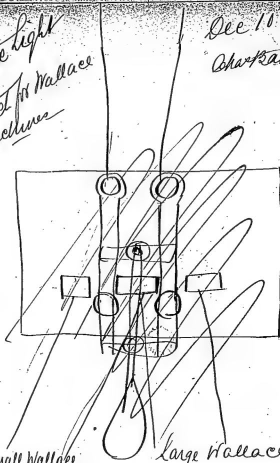
spiral has the end piece lapped over and pierced so as to let screw through to fasten to top cap

Electric Light

Dec 10 1878

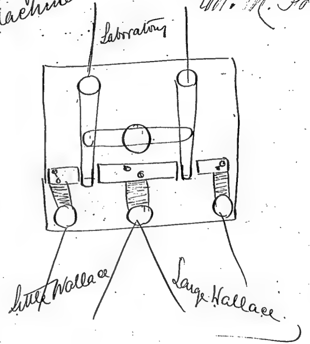
Chas Batchelor

Switch for Wallace machines



Electric Light
Switch for Wallace
Machines

Dec 10 1878
Chas Batchelor
M. N. Force

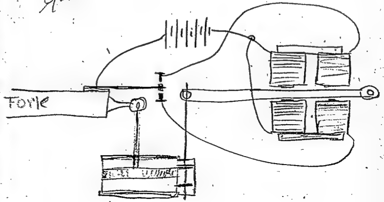


Electric Light Dec 11 1878

Tuning fork dynamo Chas Batchelor

Electric Light
Magneto Electric
Generator

Dec 11 1878
Chas Batchelor
M. N. Force



Make the [illegible] thinner & put bearing near crosshead

Connect [illegible] so as to be at rest exactly in centre of cylinder

put new collars on valve stem

Shoulder screw for armature

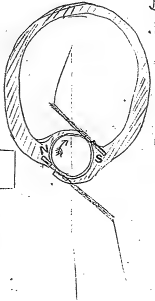
Stud instead of [illegible] of armature

[illegible] up [illegible]

Stop screws for armature

Gramme Machine
Commutator

Dec 20th 1878 19
Chas Batchelor



In Gramme armature the pole is carried round in direction of revolution. So it ought to made as in sketch with slices wheels it [illegible]

20

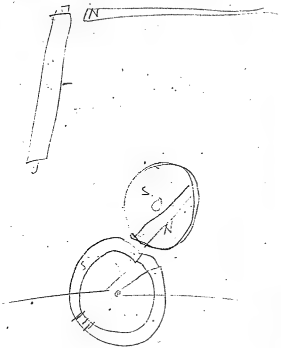
Magnetism 2

When the internal resistance of the magnet equals external the best effect is obtained. Ohms law applies to Magnetism. E

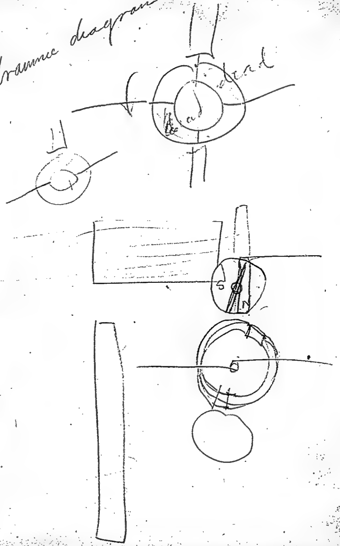
~~Pt. sp~~

A Pt. spiral moved when heated and no more light given out. Stick gave more owing to greater oxydation. E

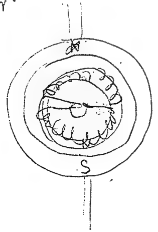
The spiral was rapidly revolved holding it in the hand.



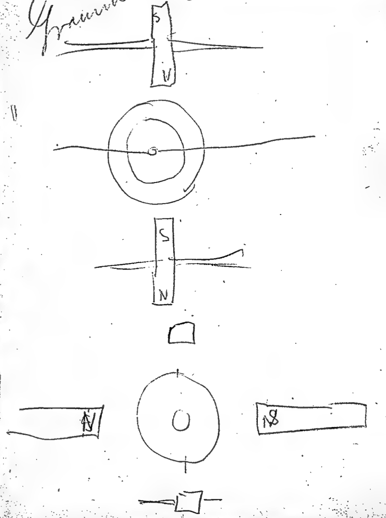
Gramme diagram

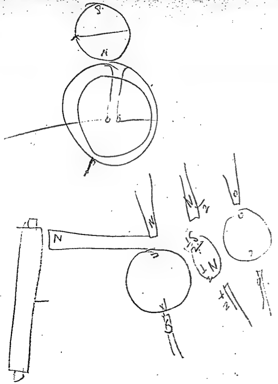


Gramme ring

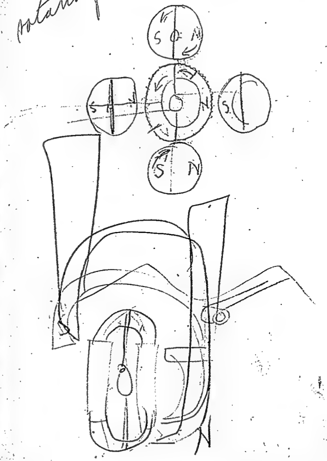


Gramme ring

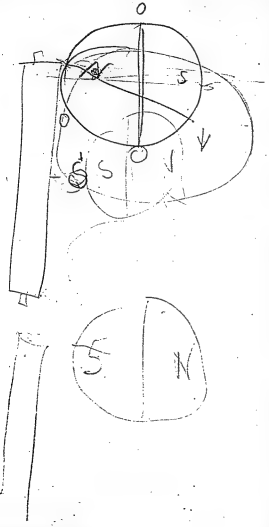




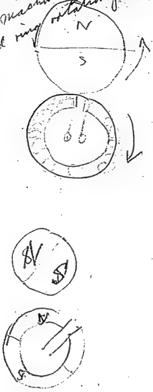
Gramme ring of
rotating magnets



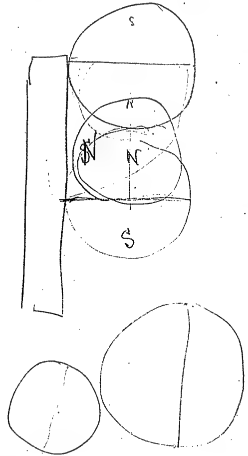
Gramme



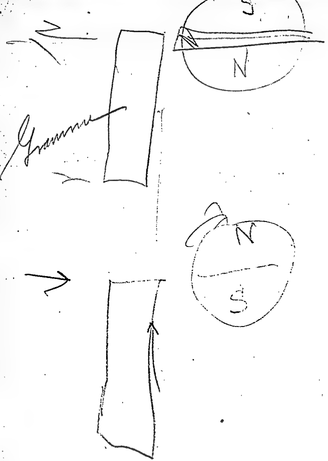
Gramme machine
magnets and ring rotating



Gramme



Gramme

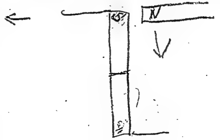


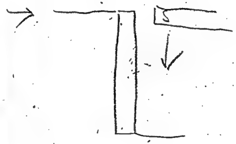
Magnetism
Law of currents induced

Weakening S same as
strengthening N

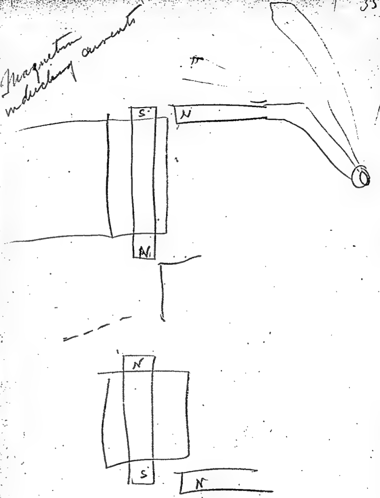
stren —— S " "
weakening N

carried in same direction

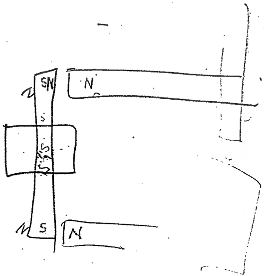


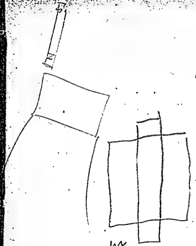


Magnetism inducing currents

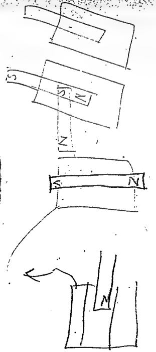


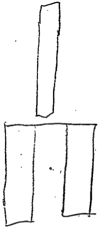
Magnetisation distribution of induced

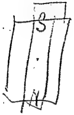


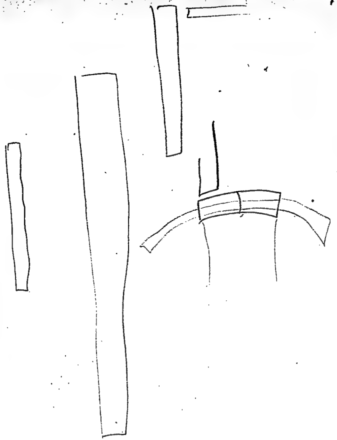


magnetism

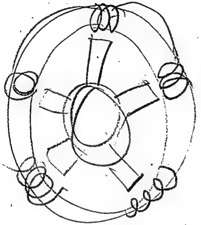


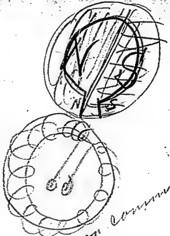




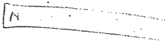


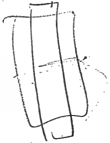
Gramme ring



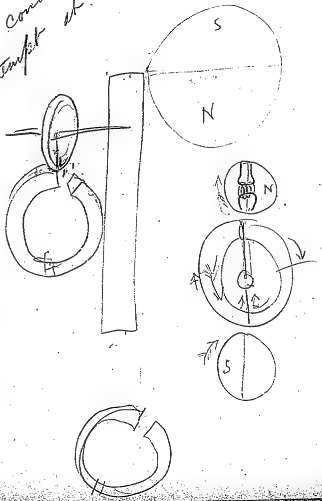


Attempt at non commutator

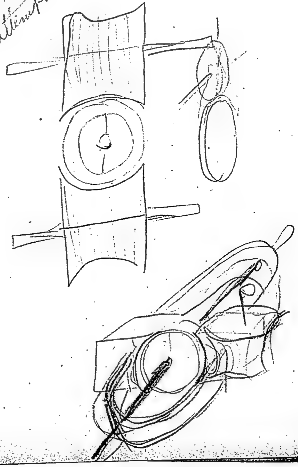


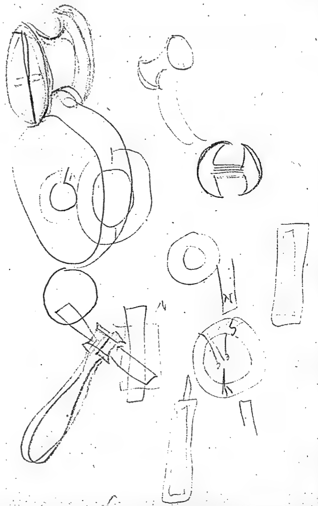


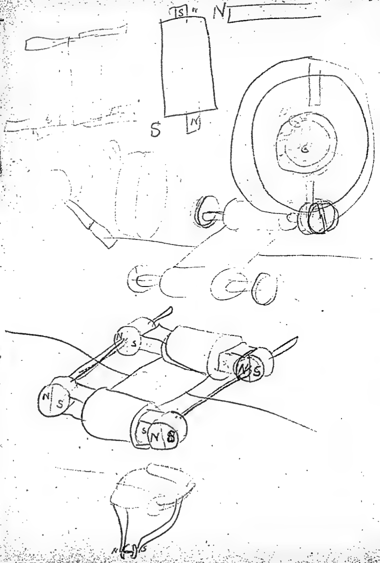
Non commutator
attempt at



More commutator
attempt at.







S N
N
S
N
N S
N S
N S
S N S
N S

84.5
15.5 3 Ohms

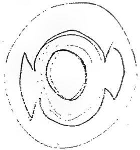
63.6
36.4 1 ohm

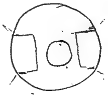
15 : 84.5 :: x : 3

84.5) 45.00 (.53
42 25
2750

63.6) 36.40 (.57
31 80
4600

Galvanometer





$39\frac{3}{4}$

No 16 wire

.065

$$\begin{array}{r} .065 \\ .065 \\ \hline 325 \end{array} \qquad \begin{array}{r} .0325 \\ .0325 \\ \hline \end{array}$$

$$\begin{array}{r} .065 \\ -\ 5 \\ \hline .07 \end{array} \qquad \begin{array}{r} .035 \\ .035 \\ \hline 175 \\ 105 \\ \hline .001225 \\ 3.14 \\ \hline 4900 \\ 1225 \\ 3675 \\ \hline .003847 \end{array}$$

1150 to the Ohm

407 feet

$$1.0038 \overline{)\ 2.24}\ (580.$$
$$190$$
$$340$$

12 ~~.104~~ ~~.1055~~

.11

$$\begin{array}{r} .1055 \\ \hline 275 \\ 275 \\ \hline .003025 \\ 3.14 \\ \hline 12108 \\ 302 \\ 906 \\ \hline .00948 \end{array}$$

$$.0094 \overline{)\ 2.24}\ (24$$
$$188$$
$$460$$
$$376$$

10

$$.015 \overline{)\ 2.240}\ (1$$
$$15$$
$$74$$

$$\begin{array}{r} .07 \\ .07 \\ \hline .0049 \\ 3.1 \\ \hline 49 \\ 147 \\ \hline .01519 \end{array}$$

134

14

4

58 12.16.

600
488

1.5

.072

.072

.036
.036

.072

.00407.1) 2240.
560

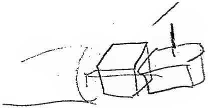
0033) 22400 (660
198
260

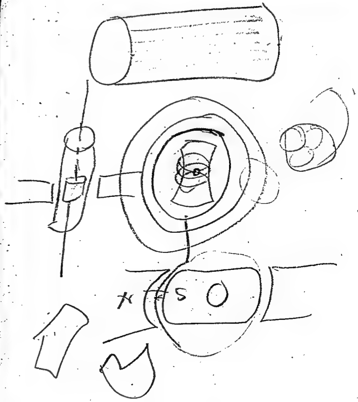
~~560~~
600

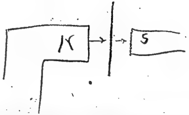
2000

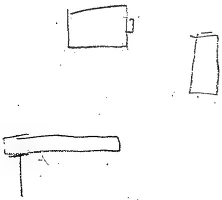
4.9

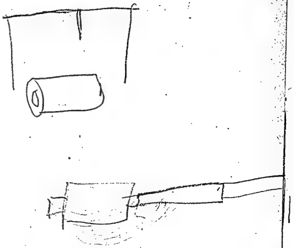
408
4
1632
12
19584
490




K
S


K
S





68.376

68.376	4.834900
1.390	3.143015
~~comp 33000~~ 95,000,000	7.977915
comp 33000	4.578514
	3.377401

60/2508. H.P. for a minute
60/41.7 H.P. in an hour

31.000 Grammes H.

68.376

68.376
772

1 lb of H will give — H.P. burned in O.

34.462	4.537345
772	2.887617
26,600,000	7.424962
33000	4.518514
	2.906448

60/806
13.4 H.P. one hour

Dechenal

1 kilo.

68,376

772

comp. log 2

34.462

67

$$\mathcal{E} = \frac{c}{R}$$

$$\frac{i}{i \times j} =$$

$$Z = \frac{i - j}{}$$

58 59

112

7

2,167,539.000 | 9.335978

209.336 | 5.321645

4.014333

10.320.

~~220 X 99~~

202 00.40)

.004)1.000(

.0039 9

.0039)1.0000 (Iron

~~I~~ 4.

8.408935

~~5.1065~~

2.408935

256° F to double

Copper

21

62	100
256	~~200~~
318	200
256	
574	300
830	400
1086	500
1342	600
1598	700
1854	800
2110	900
2366	1000

100 Ohms wanted.

~~.001~~ .01

.01 in Diam.

$\frac{9.7}{7}$ ft per Ohm

= 1.38 ft per Ohm

$\frac{100}{1}$ 138 ft per 100 Ohms

.005

$\frac{2.42}{7} = .345$

34.5 ft per 100 Ohms

When 2000° F

Resistance is 8½ times greater

$\frac{138}{8.5}$ ~~ft.~~ per 100 Ohms

2.139879
0.929419
1.210460 16.2

$\frac{34.5}{8.5}$ at 2000° F

1.537819
.929419
.608400

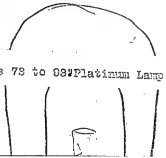
~~.005~~ .005 in wire

4.05 ft per 100 Ohms

.020

.02
3.1415
.02
.062830
7
.43901

11 — 50 commenced



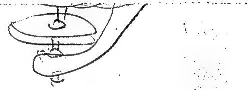
Pages 73 to 98"Platinum Lamp Notes". Unimportant

Edison Laboratory Note Book # 2.

Page 73.

See Edison Patent

227,229

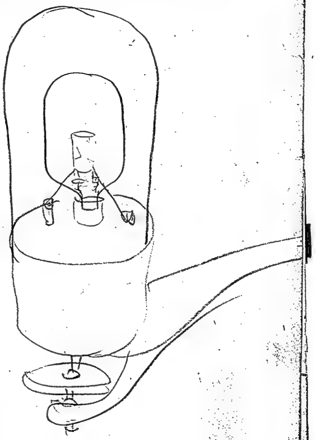


.020

.2

.062830

7



~~1.1004~~

~~1.000~~

Feb. 8 1879

Platinum Iridium .020 Ri

wound in spiral on

heated once for a

moment to redness in air

then weighed.

Wt. 1.1004 gms (1)

11-55

Then placed in a vacuum

brought to a bright red

Vacuum .2 in 3 cells

kept at red 10 minutes

6 cells incandescent

Sable

	Loss	Total
1.1004		
1.1000	.0004	.0004

.0004/1.1000.0

4/11000

3/2750

4/916

6/279

49 Days

49
6
294

to lose 1/4

9 cells 11-45 a.m

Full incandescent

Lower part of the coils seemed to be cross circuited as two turns remained cool

11 cells very white

12 cells 11-48 a.m.

Vacuum holds at 2

Taken off at 11-52 a.m

1.1000 Gr weights (2)

1.1.004

$\frac{4}{1.1004}$ $\frac{1}{2751}$

1

1004

1

$\frac{4}{10000}$ $\frac{4}{}$

12.38 PM
Spiral—White heat
8 cells C&H New fluid
Vacuum—2 —

12.44 we put 9 cells on
12.47 we put 10 cells on
12.56 " " 11 " "
1. 2 PM 12 cells
1.20 White 13 cells
1 29 White after a shaking
1 38 Yellow

3 Wt 1.0998 Grams.

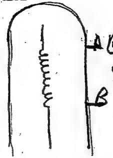
1:54 P.M Vacuum .2
Acid added out line
6 cells
2 P.M 8 cells white
2-5 " 10 " "
Noticed on the glass a few
"Transparent crystals probably
from dirt on the substance
wh. have been placed in
it as it was not thoroughly
clean when Ex. commenced
Seemed to have distilled
from the top of glass can

2.25 P.M. 13 cells

Lost .000$\frac{1}{2}$

= .00005

Noticed a black coating around the wire wh, seemed to have a metallic lustre, when looked at against a dark



Between ~~these~~ A & B Extremely thin scarcely noticeable

Gramme Machine

3-35 Very full white

Galva 60°

About 4 Ohms in circuit

lamp probably .8 Ohm

The vacuum was once very poor

Look out 4'09

Measured resistance cold lamp .73 Ohms

total 3.3

.78

2.6

Platinum Spiral

Put in 8.51 P.M.

Weight 1.1243 mgm

60
16
76
6

Taken off 8.57

Put on again 9.02

Taken off 9.10

Put on again 9.11

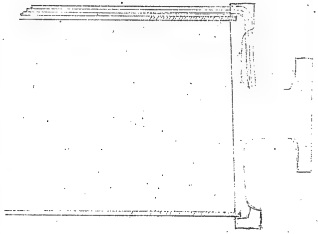
Taken off 10.07

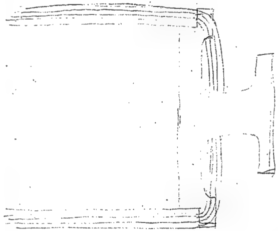
been on 70 minutes

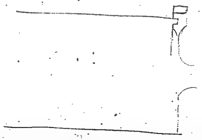
It now weighs 1.1242

having lost 1/10 of a mgm

Put it on again 10:20
Took it off at 10:50
Weighed 1.1240
Lost in 100 minutes 3/10 mgm
Put it on again at 11 p.m.
for an hour
took off at 12 m
Weighed 1.1237







375 = 9375
25
1875
750
9370

2.985

314) 9.375
628
3095
2826
2690
2512
1780

= 125
3.5
1125
942
1830

138

$\frac{1000}{138} \times 68$

$23 \overline{)10000} ($

$\frac{1020}{138} \cancel{60}$

$23 \overline{)1020} (44,39$

92

100

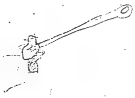
92

80

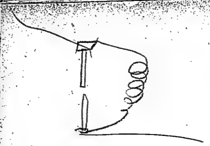
69

210

207



The invention is for regulating the distance apart of the Carbon Electrodes = and he in 1 case uses the movement in a metallic conductor due to the passage of the current to effect directly or to release certain mechanism to effect the ~~first~~ separation of the Carbons



He shunts the arc with a magnet or solenoid, & in 6-[illegible] pp 44 & 49 Says that he uses the Expansion of wire to effect the separation of the Carbons of the magnet to release the mechanism, this magnet forms a Constant derived Circuit around the arc

~~in another arrangement~~

~~He~~

In 1 case he inserts a fusible wire in the derived current around the arc containing the magnet to prevent its destruction with great current.

in another arrangement

His fusible wire, see fig 4, Line 9410 (which is not the expansible wire)

this fusible wire connects to a commutator which

comes in play only when the wire fuses. and thus preserves the continuity of the circuit, so that other lamps shall continue to burn; now the expansion of this fusible wires produces no effect whatsoever as it only can work by its fusion & when the lamp has reached a point it cannot work

~~Hd~~

In one case he mentions that a uni-metallic device may replace the fusible wire around the Carbon points, whose expansion may connect ~~and~~ the commutator ~~and the ... of ... is ... close so as to close the circuit of the ... of the is the case~~ the circuit of the arc, now if this

Expansion wire is around the arc; ~~it would permanently short circuit it owing to its low resist... & the .... that it is to replace the fusible wire, if it was in the ... circuit~~ outside of the lamps (~~...~~ and forms a derivation around it in connection with the releasing mechanism of the magnet

it would Expand ~~...~~ upon the arc being broken by a greater accession of

Current thus it is supposed would bring the Commutator into play & short circuit the arc, but the effect of this Expansion is not to throw in & out resistance because the resistance is always in circuit & is independent in this ~~galvanism~~ of the movement of the Expansible wire.

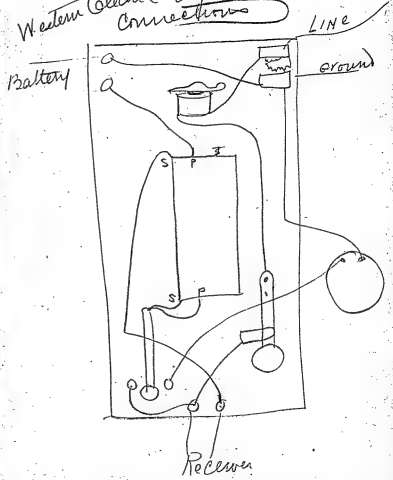
not only does this device not throw in & out resistance ~~of~~ in the line Either to regulate or vary the strength of the Current but is only used in cases when the ~~lamp off arc has~~ light has been destroyed it ~~has not~~ neither does it regulate in any manner the Carbon of the Lamp

It will be noticed
that the resistance
which he uses is always
in the line, and is of
such an amount that it
is proportioned to the
strength of the Current
Further that he does
not describe, allude or claim any method
~~or~~ whereby the expansion of
a conductor is made to
throw in & exclude from

a circuit a resistance,
I wish further to remark
~~that I~~ have submitted
the Specification and
drawings to several skilled
Expert in ~~that~~ art to
which it relates and
~~that~~ they are unable
to any similarity between
the two inventions = not only do ~~written~~
they see no ~~sim~~ similarity but I
~~Can~~ they ~~cannot~~ cannot understand
how an operative mechanism
could be made from the

general and Confusing
Statement of the patent
in question

Western Electric Telephone
Connections



2 cts.

365

	36.50	36.50
		18.25
	2	54.75
36.50	73.00	2
2	2	10950
7300	14600	2
2	2	21900
14600	29200	2
2	2	43800
29200	58400	

73. × 24 = 292, 146, 1752

54.75 × 24 = 21900, 10950, 1314.00

36.50

5/16

16) 5.0 (.3125
48
20
16
40
32
80

.004

.3125 inches surface

.03125 inches a straight line having 10 ohms

004
314
.01256
3
.03768

8) 12.5 ohms
4.13 in 4 inches

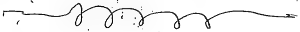
.005 .00

.003

.004

4 inches 4)64
16

64



44.
16
264
44
704
176
528 ft. lbs

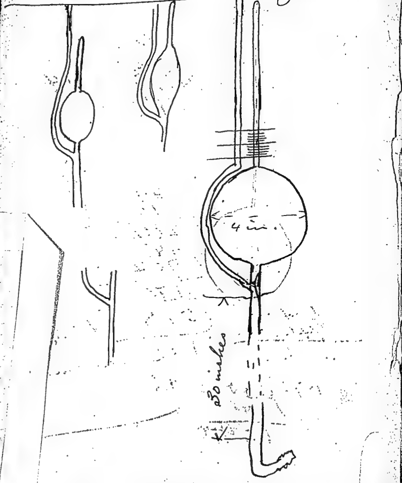
64

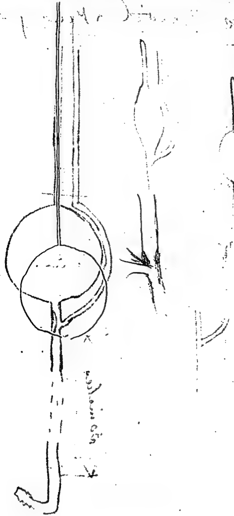
64
44
2 6

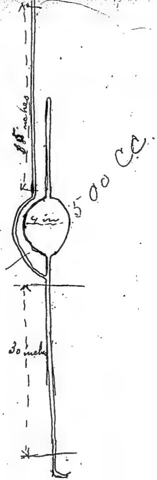
176 per candle

176)33000(18
176
1540

Mac Cleod Guage






inches
4 in
500 CC.
30 inches

.76

3800
8
30400

6

64.

64) 3800. (5-9.
320
600
576

64
59

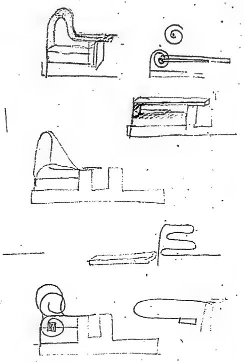
64
60
3840.

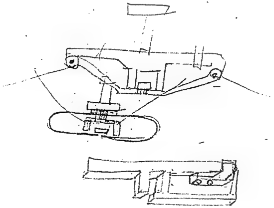
1

5 100

2

1 2





~~160~~ 2.2041
~~772~~ 2.8872
~~40~~ 1.

6.091.3

1,230,000

6.0913
4.5185
1,5728

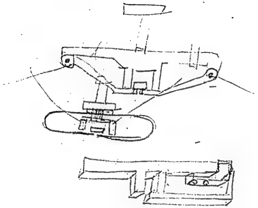
33.000

37.4

3/39
13

4

3/4.00
3/1.333
4/.444
.111



~~960~~ 2.2041
~~972~~ 2.8872
~~10~~ 1.

6.0913

1,230,000

6.0913
33.000 4.5185
1,5728

37.4

4

3/4.00
3/1.333
4/.444
.111

3/39
13

	P.	S.	T.
1	.41	118	405
2	.41	116 with bells	380
3	.42	140	405
4	.43	.140	430
5	.42	145	430
6	.43	147	427
7	.35	145	372
8	.43	143	427
9	.35	150	425
10	.43	140	430
11	.43	142	442
12	.46	135	400
13	.43	1.37	420
14	.45	136	410

140

New Coils with proper amount of Resistance

Sept. 29

Number of Instrument

25 X
36 X
34 X
28 X
43 X
49 X
32 X
43 X
39
29

X means good

35 good. R. S with B T changed

48	.47	124	347
38	.40	122	370

49

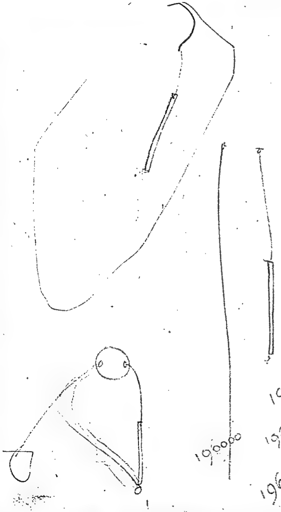
49.

141

Tests of Coils of Edison telephones

Sept 19th 1879

No of Inst	Primary	Secondary	Tertiary	Remarks
33.	OK .32	with Bell 141	350	
23	.40	141		
34	.20	125		must be fixed
43	OK. 25			
41	.40	143	417	
36.	.20	—	—	investigate
29	OK. 21			investigate
46	.24			investigate
49	OK .05			Big bug
51	.34	153	370	
37	.40	128	379	
26	.41	with Bell 142	377	
31	.26			
33	.31	143	375	
43	.24	130	372	
46	.44	174	435	



19667

196966

19000

190000

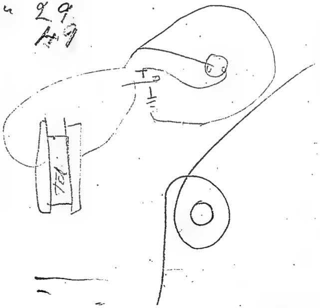
196000

19676

No 29 - 23 Light pressure - Heavy press

Nos. of Telephones ~~with~~ where
coils ~~have~~ been changed

No 32
" 43
" 39
" 29
49



	Light pressure	Heavy pressure 7.45
No 49	5.	
No 29	23	11.20.
" 36	6.30	2.9.
43	16.5	7.3
34	Insulated at all pressure	

20.

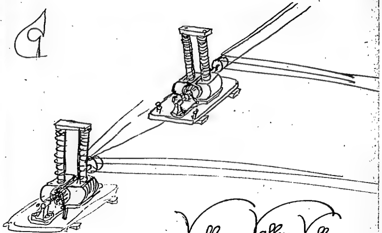
45

Test to ascertain reliability of resistance in hard carbon buttons,

NO	LIGHT PRESSURE	HEAVY PRESSURE
29	23.00	11.20
36	6.30	2.9
43	16.5	7.3
34	Insulator	Insulator.
46	3.0	2.0
34 Thompson Carbon	11.20.	5.
our Lampblack Carbon. Eddys - squirted	33.00 = little heavier Pres .24 ohms	14.
ditto filed flat	ohms 47.95	ohms 12 ½ (very heavy = 4 (.3
again	33 ohms = talking loud 26	again 27.40 again talking 92.
Pure Plumbago	6.80.	1.61

McLaughlin has just returned from
the Chandiere River & the Leloup
Canada where there are placer mines
This alluvial is said to contain
a minute trace of Platinum & Iridosmine
McL brings some of the black sand
from the sluices before the fine gold
is panned from it. By the aid
of the Microscope I ascertain that
The platina is combined with the
gold also in separate pieces,
The Pt is not alloyed with Au but
is in Contact with it. - The amount
of Platinum is about $\frac{1}{4}$ that
of the Gold. Iridosmine is very
plentiful. It forms a large

bulk of the sand there is
probably 6 oz of Iridosmine
to every oz of gold, I have
found that Sodium amalgam
will take up the ~~Iridosmine~~ &
platinum, the Au being previously
taken out by pure mercury –
There is undoubtedly enough
Pt & Iridium in the Canada
district to supply the world
instead of the Blocks and
Containing a trace of the platinoid
The mine should be called a
platinoid mine with trace of
gold – T. A. E –
June 6 1879 –



Valley Valley Valley

Portchester

Wabash

Portchester Valley

Portchester

Portchester Wabash

Memphis Memphis
The substitution of the efficacy due to

Memphis

Portland maine Maine Maine
Now by Saint Paul my Golden
Maine Maine Maine

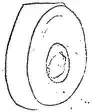
Memphis Memphis
Frangapani
Memphis Memphis Frangapani
Valley Valley Valley Valley

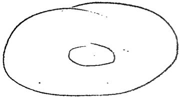
Saturated economics Economics
Chandsers Economies
Chandiere
Franklincte
Chandiere Chandierix
Circumference
Chandiere Frangapani
Chandiere
Frangapani

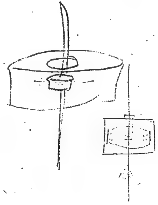
Saturated Soulution of Caustic
potash =
fuse ~~the~~ solid salt of
Caustic potash & also
of Soda in molten state
pour in a mould & then
turn them off =

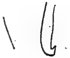
also fuse the Caustic soda
mixed with 1/4 its weight of
chalk mix & pour hot =
Ditto with the potash ~~solution~~ salt

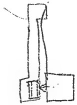
again make another
and mix 1/2 its weight of
Chalk =

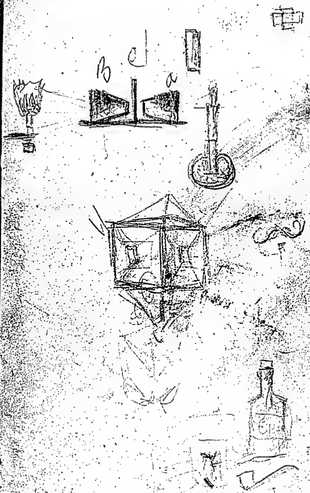








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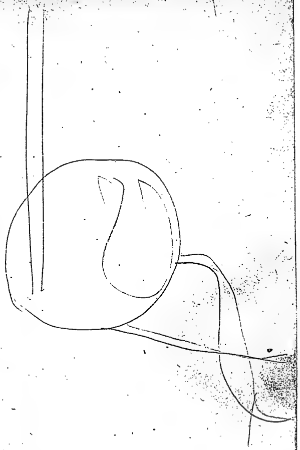
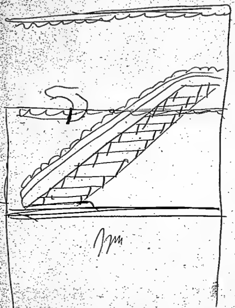


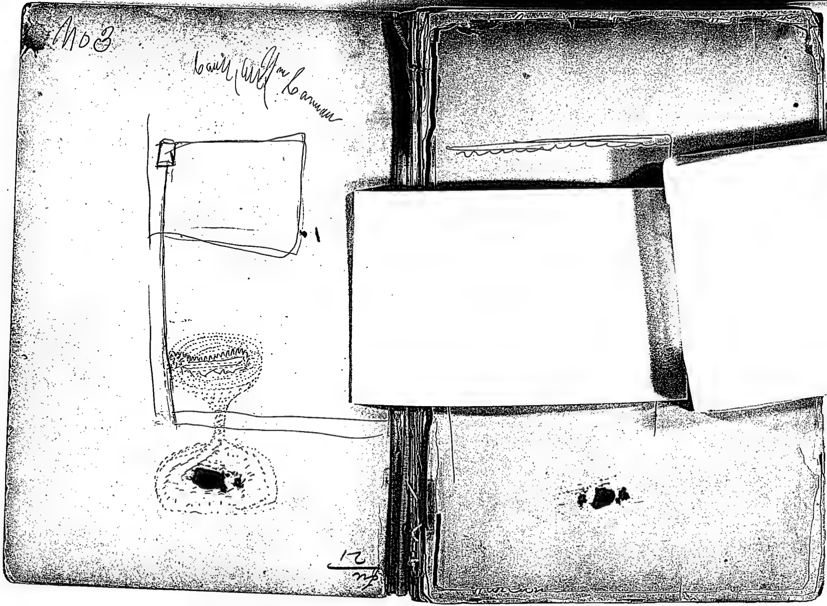
Menlo Park Notebook #3 [N-78-11-21]

This notebook covers the period November 1878-January 1880. It contains tests for non-radiating substances conducted by John K. Knight during November and December 1878 and results of Knight's research to find a chemical to extend the red spectrum. There are also entries by Edison, Charles Batchelor, Francis Upton, and John Kruesi. These include notes, drawings, and calculations about generators; drawings of lamp sockets; miscellaneous drawings, calculations, and experiments relating to electric lighting; notes by Edison on thermopiles; and notes by Batchelor on Edison's telephone. The book contains 282 numbered pages.

Blank pages not filmed: 24-25, 82-83, 116-117, 158-161, 194-199, 202-237, 242-249, 252-281.

No 3




No 3
Cavill Will^m Cameron
12
mf

Tests for Non Radiating Substances

Source of Heat Cube of Hot Water 19[illegible]
Fr — Thermopile & Galv

Constant of Tin Cube 5 deg

Substance	Degrees deflection
Amygdaline 1/100 sol	4°
Eosine of Iron 1/20	8°
Caustic Potash 1/20	7°
Caustic Potash & Gum Benzoin	6°
Glycerine Sol 40/[illegible]	10° X
Gum guiacum 1/100	10°
Manganese Sulfate	8°
Tartaric Acid	6°
Bismuth Nitrate	11°
Mercuric Nitrate	4°

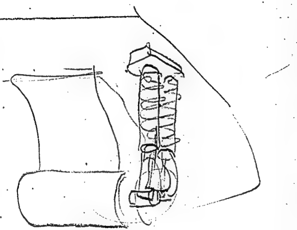
Continued Nov 21 & 22 98 HKR

Chemicals	Degrees deflection	
Chloride Lime	6°	
Ammonic Oxalate	10°	
Sulph Magnesia	6°	
Lamp Black	20°	X
Glycerine	21°	X
Lamp Blk & Glycerine	21°	
Caustic Potash Sol	10°	
Phosphate Lime & Glycerine	21°	
Pepsine Sol. 1/20	11°	
Gum Shellac & Caustic Potash Sol 5/100	12°	
Valerianate of Zinc 1/100	8°	
Licorice Sol 20/100	18°	
Gum Arabic " 1/100	11°	

4

Continued Nov. 22/78
 23/78
TAE

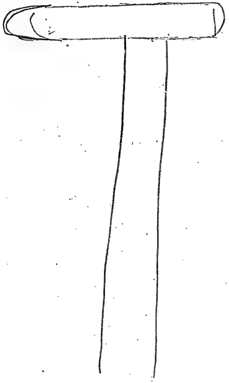
Chemical		Deflection
Tannic Acid	1/20	14°
Sulph Copper	1/20	15°
Chrome Alum		16°
Paris Green		19°
Spermaceti		9°
Cocoa Butter		16°
Starch		7°
Starch Iodide		12°
Bronze on Glycerine		10°
Sulph Iodide		8°
Sulph Antimony		10°
Sulphur in Sperm Oil		9°
Sulphur in Bi Sulph Carbon		8°



OKR

Chemicals	Deflection
Ammonia Water	7°
Sulph Potash - Sat.	8°
Sulph Antimony in Bi Sulphide Carbon	10°
Nitrate Strontia 40/100	9°
Aloin 1/100	12°
Paper White	8° ×
" Glycerine	20°
" Lampblack	18°
" Litmus Sol	10°

over



Continued Nov 25. 98

JKK.

Chemicals	Deflection
Paper Camphoric Acid 1/100	13°
" Chloride Lithium 1/5	9°
" Hyposulphate Soda 1/5	11°
" Cyanide Mercury 1/100	12°
" Sulphate Quinine 1/100	10°
" Acetate Nickel 6/100	9°
" Dextrine Sol	10°
" Balsam Copabia	14°
" Balsam Peru	20°
" Venice Turpentine	15°
" Collodion (Thin)	5°
" " (Thick)	4°
" Albuminized (only)	8°

Continued. Nov 26. 98.
H Knight

	Chemicals	Deflection
Paper	Oil Rosemary	9°
"	Coach Body Varnish	10°
"	Wearing Body Varnish	9°
"	Oil Wintergreen	11°
"	Oil Pennyroyal	13°
"	Creosote	12°
"	Cade Oil	18°
"	Tannic acid	4°
"	Oil Citronella	9°
"	Oil Tansey	10°
"	Oil Spruce	12°
"	Balsam of Fir	14°

Continued Nov 27. 78
T. K. Knight -

Chemicals	Deflection	
Paper Oil Spearmint	9°	
" " Bergamot	9°	
" " Sassafras	12°	
" Furniture Varnish	15°	
" Oil Cubebs	14°	
" Union Salad Oil	10°	
" Bi Carb Soda	8°	
" Bi Chrom Potash	11°	
" Chloral hydrate	12°	
" Dextrine & Acetic Acid	6°	X
" Arenomic Acid	4°	

Continued. Nov 28. & 29. - 1878.
J. Kingsley

Chemicals	Deflection
Paper Lead Acetate	12°
" Sulph. Potash	10°
" Chloride Zinc	10°
" Chloride Ammonia	15°
" Sodic Nitro Prusside	10°
" Permanganate Potash 5/100	10°
" Tartarate Manganese 1/100	12°
" Dextrine & Fluor Spar	5°
" Gamboge	8°
" Anthracate Potash	8°
" Caustic Potash 5 Grms, Gum Sandaric 5 ", 100 H.O	11°

Continued Nov 29. 1878
" 3 D. A. Knight

Chemicals	Deflection
Paper Chrome Alum	12°
" Phosphate Lime - Gum	10°
" Blk. Ox Manganese "	6°
" Fluor Spar "	4°
" Silicic Acid "	10°
" Caustic Baryta "	7°
" Gum Tragacanth "	13°
" Powdered Marble "	8°
" Burnt Umber "	10°
" Tellurium Ore "	12°
" Fire Clay "	11°

Continued Nov 30 & Dec 2. 78

D. K. Knight

Chemicals	deflection
Paper Tripoli - Gum	8°
" Rotten Stone	10°
" Celluloid (Thick)	10°
" Marble "	9°
" Rotten Stone "	9°
" Gum Damar	12°
" " " Fluor Spar	9°
" Mica (Thin)	10°
" Chalk	
" Alumina	12°
" Caustic Magnesia	11°

Continued Dec 2 78 TAE
3 78

Chemicals	Deflection
Paper Carb Baryta	9°
" Fire Clay & Collodion	40
" Chalk & Collodion	40
" Blk. Oxide Mang & do	5°
" Chalk & Asbestos	8°
" Chalk (Thin)	11°
" Crocus Antimony Plast Paris	40
" Blk Ox Manganese " "	8°
" Plaster Paris	10°
" Peroxide Lead " "	12°
" Hypophosph Iron " "	40

Thick deposits

Dec 6. 1898

[signature]

Spectrum Tests

To find a chemical that will Extend the Red Spectrum

Picate Ammonia	1 gr 100 H₂O	Reduces
Chlor Barium	1 " 100 "	Reduces
Acetate Zinc	5 " 100 "	Reduces
Flavonde: Sodium	.1 " 100 "	Reduces Slightly
Sulpho Carbolic Lime	1 " 100 "	Reduces "
Baptisn	1 " 100 "	Reduces "
Chloride Lead	1 " 100	Reduces
Acetate Uranium Potash	5 " 100.	Reduces
Iodide Potassia	1 " 100 "	Reduces
Gum Senegal } =	{ 5 "	} Reduces
Caustic Potash	{ 1 " 100 "	
Citric Acid	20 " 100 "	Reduces
Iodide Zinc	5 " 100 "	Reduces
Arsenious Acid	5 " 100 "	Reduces

Dec 6th am ad 1898

Jno. K. Knight

Carbozotate Ammonia	1 gr	100 Ho	Reduces
Oxalate Ammonia	5 "	100 Ho	"
Salicine	5 "	100 Ho	"
Chloride Ammonia	1 "	100 Ho	" Slightly
Sulph Quinine	100 Ho	100 Ho	" "
Acetate Strontia	5 gr	100 Ho	Reduces
Caustic Baryta	5 "	100 Ho	" "
Chloride Strontia	20 "	100 Ho	" Slightly
Sulphate Lithia	1 "	100 Ho	Reduces
Sulphate Caffeine	1 "	100 Ho	"
Protochloride Tin	5 "	100 Ho	" Slightly
Picrotoxin	500 M	100 Ho	No Variation
Sulph Morphia	1 gr	100 Ho	Reduces
Boracic Acid	3 "	100 Ho	"

Over

Dec 7th 1878

[illegible signature]

Spectrum Test - continued

Sulphide Magnesia	1 gr 100 H2O	Reduces Slightly
Amygdaline	1 " 100 "	No difference
Sulpho Vinate Soda	20 " 100 "	Reduces
Sulphate Alumina	5 - 100 -	Reduces
Iodide Calcium	5 . 100 .	Reduces Slightly
Lupuline	1 - 100 -	Reduces
Sulpho Carbolic Soda	5 100	Reduces Slightly
Sulpho Cyanide Pottassium	1 " 100 -	No Change
Sulphuret Calcium	1 - 100	Reduces
Valerinate Zinc	1 " 100 "	No Change
Acetate Nickel	6 - 100 -	Reduces
Proto Acetate Copper	1 - 100	Reduces

over

Dec 9th 1878
Jno. K. Knight

Spectrum Tests: continued

Hyposulphite Manganese	1 gr. 100 HO	Reduces
Acetate Alumina	1 gr 100 HO	Reduces
Camphoric Acid	1 gr 100. HO	Reduces
Alum	1 gr. 100 HO	Reduces slight
Valerianate Magnesia	1 gr 100 HO	Reduces
Manganate Soda	1 gr 100 HO	Reducts
Stannate Soda	5 gr 100 HO	Reduces
Camphoric Acid	20 gr 100 "	Reduces lit
Sulphate Soda	20 gr 100 "	Reduces lit
Nitrate Strontia	1 gr 100 HO	No variation
Sulphate Cobalt	1 gr 100 HO	Reduces
Arseniate Soda	5 gr 100 HO	Reduces

Dec 9th 1878
Jno. R. Knight

Spectrum Test Continued

Citrate Potash	1 gr 100 H_2O	Reduces
Sulph Quinidine	200 mil 100 H_2O	No diff
Citrate Quinine	100 mil 100 H_2O	Reduces
Hyposulph Soda	1 gr 100 H_2O	Reduces little
Hippuric Acid	150 m 100 H_2O	Reduces
Arsenate Quinine	1 gr 100 H_2O	Reduces
Carbonate Soda	20 gr 100 H_2O	Reduces
Hyposulph Soda	20 gr 100 H_2O	Reduces less
Citric Acid	40 gr 100 H_2O	Reduces
Phosphate Lime	1 gr 100 H_2O	Reduces

Dec 10 1878

Jno. Knight

0

Spectrum Tests Continued

Gum Arabic	20 gr	100 HO	Reduces
Oxalate Soda	3 gr	100 HO	Reduces
Arsenite Soda	5 gr	100 HO	Reduces
Sulphate Zinc	5 "	100 HO	Reduces little
Sulphuret Barium	1 "	100 HO	Reduces
Tartarate Soda	20 "	100 HO	Reduces
Bi Carb Soda	8 "	100 HO	No percept. change
Tungstate Soda	20 "	100 HO	Reduces
Borate Soda	8 "	100 HO	Reduces
Bromide Potassium	20 "	100 HO	Reduces slightly
Bromide Cadmium	5 "	100 HO	No change
Chlorate Potassa	3 "	100 HO	Reduces

Dec 10th 1898 Jno. [illegible]

Spectrum Tests Continued

[illegible]

Formate of Copper 1 gr 100 HO		Reduces
Sulphate Uranium 5 gr	100 HO	Reduces
Bichromate Potash 3 gr	100 HO	Reduces
Phosphate Ammonia 5 gr	100 HO	Reduces Slightly
Cochineal Sol	— —	Reduces
Phosphorus in Bi Sulp Carbon	— —	Reduces little
Trichromate Ammonia 5 gr	100 Aq	Reduces
Formiate Soda 5 gr.	100 HO	Reduces little
Sulphate Magnesia. 40 gr	100 HO	Reduces
Per Nitrate Iron	Pinkham Sol	Reduces
Acetate Baryta 5 gr.	100 HO	Reduces
Mollybdaenic Acid 200 m	100 HO	Reduces Slightly
Mercuric Nitrate	—	No Change

Dec 11 th 1878
J Kingsbury[?]

Spectrum Tests Continued
Dec 11.78 JKK

Lead Acetate	——	Reduces little
Sulph Potassium	——	No apparent Change
Oxalate Soda	1 gr 100 HO	Reduces
Pepsin	1 gr 100 HO	Reduces little
Nitrate Magnesia	1 gr 100 HO	Reduces
Citrate Ammonia	1 gr 100 HO	Reduces little
Nitrate Uranium	1 gr. 100 HO	Reduces
Saponia	1 gr 100 HO	Reduces
Chloride Uranium	1 gr 100 HO	Reduces little
Phosphate Manganese	1 gr. 100 HO	Reduces
Lacto Phosphate Bismuth	1 gr 100 HO	No Change
Phosphate Potash	1 gr 100 HO	Reduces

over

Dec 11th 1878 Jno Kknight

Spectrum Tests Dec 11 78 Kknight

Chloride Strontia	20 gr 100 Ho	Reduces
Phosphate Calcium	1 gr 100. Ho	Reduces little
Grape Sugar	20 gr 100 Ho	Reduces
Bi Carb Potash	5 gr 100 Ho	Reduces
Phosphate Amm of Soda	5 gr 100 Ho	Reduces
Monochloric Acetic Acid	5 gr 100 Ho	No change
Sulph Cinchonidin	1 gr 100 Ho	Reduces little
Sulphate Strontia	1 gr 100 Ho	Reduces
Sulphate Strychnine	1 gr 100 Ho	Reduces
Citrate Potash	5 gr 100. Ho	No Change
Hyposulphate Baryum	5 gr 100 Ho	Reduces little

44

Dec 13th 78
Jno K Knight

Spectrum Test Dec 12. 78 43
John K Knight

Acetate Strychnine	1 gr 100 HO	Reduces little
Iodide Zinc	1 gr 100 HO	Reduces
Acetate Barytum	5 gr 100 HO	Reduces
Nitrate Silver	1 gr 100 HO	Reduces
Flouride Sodium	5 gr 100 HO	no change
Lactate Quinine	1 gr 100 HO	Reduces
Sulph Lead	5 gr 100 HO	Reduces
Chloral Hydrate	1 gr 100 HO	Reduces little
Chlorine	—	Reduces
Magnesium Sulph & Am Ch	—	Reduces
Stannous Chloride	—	Reduces
Sulphate Lime	1 gr 100 HO	Reduces

over

Dec 13th 1878
Thomas A. Edison

Spectrum Test Continued
Dec 12-78 JKK

Asparagin	1gr	100 HO	Reduces little
Propylamin Chl	1gr	100 HO	Reduces
Iodide Amm	1gr	100 HO	Reduces
Glycerine	5gr	100 HO	Reduces little
Venice Turpen -	5gr	100 HO	Reduces
Caustic Potash =	1gr	100 HO	
Gamboge	2gr	100 HO	Reduces
Carbazotic Potash	3gr	100 HO	Reduces little
Sulphate Beberine	1gr	100 HO	Reduces
Balsm Peru Caustic Potash	1gr 2a	100 HO	Reduces
Sesqui Chlor Iron	5gr	100 HO	Reduces little

Over

Dec 13. 1878

Jno. K. Knight

Spectrum Tests Continued

Dec 13, 78, JKK

Gamboge	5 gr	100 Ho	Reduces
Caustic Potash	1 gr		
Gum Benzoine	5 gr	100 Ho	Reduces
Caustic Potash	1 gr		
Balsam Tolu	5 gr	100 Ho	Reduces
Caustic Potash	5 g		
Gum Guacum	5 gr	100 Ho	Reduces
Caustic Potash	1 gr		
Hydro Potassic Tartarate	—		Reduces
Potassic Hydrate	—		Reduces little
Potassic Carbonate	—		Reduces
Potassic Tartarate	—		No change
Potassic Nitrate	—		Reduces little

Dec 13. 1878

Geo. H. Knight

Spectrum Tests Continued

Dec 13. 1878

Hydrosulphuric Acid	Reduces like
Benzoic acid	No change
Chlorine Water	Reduces
Nitro Hydrochloric acid	Reduces like
Cupric Sulphate	Reduces
Cupric Nitrate	Reduces like
Chromic & Potassic Sulphate	Reduces
Nickel Sulphate	Reduces
Anthracali Potassium 5 gr. 100 H_2O	Reduces
Mercuric Chloride	Reduces like
Argentic Nitrate	Reduces
Ammonic Molybdate	Reduces like

Dec 14th 1878
Jno Kruesi

Spectrum Test Continued

Dec 14 1878 JKK

Palladic Chloride	Reduces
Indigo Solution (weak)	Reduces
Ferric Chloride	Reduces sl
Ammonia Water	no change
Solution Persulphide Arsenic in Ammonia	Reduces
Lithmus Solution	Reduces
Sodic nitro Prusside	Reduces
Tannic Acid	Reduces
Ammonia Sulph Hydrate	Reduces slight
Pyroxylic Spirit	Reduces slig
Benzine	Reduces slig

Dec 14 1878

J K [illegible]

Spectrum Test Continued
Dec 14th 1878 JKK

Sesquichloride Iron Sol.	Reduces
Sulphurous acid	Reduces little
Alcohol —	Reduces little
Alcohol & Cochineal	Reduces.
Alcohol & Caustic Soda	Reduces little
Alcohol & Cadmium Chloride	Reduces little
Alcohol & Santonine	Reduces slightly
Sol Quinine in H_2O	Reduces
Sol Quinine in Alcohol	Reduces
Alum water —	Reduces little
Glycerine, strong	Reduces little
Glycerine & Chlor Iron	Reduces

Dec 14th 1878 J. A. Knight

Spectrum Test Continued

Dec 14 '78 JKA

Balsam Caporia on Mica	No Change
Alcohol & Salycolic Acid	Reduces little
Balsam Caporia & Oil Lemon	Reduces little
Glacial Posphoric Acid	Reduces
Crystal Ferro Cyanide Potasium (transparent)	Reduces little
Alcohol & Gum Hemlock	Reduces
Paraffin on glass Transparent	No Change
" " " White	Reduces
Silicate of Soda	No Change
Oil Fennel	Reduces slightly
Lard Oil	No Change
Oil Spearmint	Reduces

Dec 16th 1878
Jno. [illegible]

Spectrum Tests Continued

Dec 19 1878 GKK

Alcohol & Anilin Sulphate	Reduces little
Oil Cloves on Mica	Reduces
Oil Juniper berries on "	Reduces
Oil Wormwood " "	Reduces
Oil Croton " "	Reduces little
Oil Lemongrass " "	Reduces little
Oil Peppermint " "	Reduces little
Oil Bergamot " "	Reduces
Oil Pennyroyal " "	Reduces
Oil Anise " "	Reduces little
Oil White Thyme " "	Reduces little
Oil Juniper wood " "	Reduces

Dec 16th 1878 J.W.Pruyn [illegible]

Spectrum Test — Continued
Dec 16th. 1878. J.K.

Oil Citronella on Mica	Reduces ab
" Orange " "	Reduces
" Lavender Flowers " "	Reduces
" Carui " "	Reduces
" Cassia " "	Reduces
" oil Rosemary " "	Reduces
Hydrochloric acid & Ammonia Fumes	Reduces
Crystal of Gum Damar	Reduces
" " Alum	Reduces
" " Camphor	Reduces
" " Saltpeter	Reduces
" " Gum Sandric	Reduces

162

Dec 17 1887 [illegible]

Spectrum Tests continued 63

Dec 17th [illegible] JKK

Crystal of Ferrous Sulphate	Reduces
" " Sulph Copper	Reduces
" " Bi Chromate Potash	Reduces
Glycerine & Picrotoxin	Reduces
" " Amygdaline	No change
" " Sulphate Quinidin	Reduces little
" " Valerinate Zinc	Reduces little
" " Nitrate Mercuric	Reduces
" " Sulphate Potash	Reduces little
" " Lacto Phosph Bromine	Reduces little
" " Bromide Cadmium	No Change
" " Bi Carb Soda	Reduces little
" " Ammonia Water	No Change

Dec 17 1878 [illegible]

Spectrum Tests Continued
Dec 17th 1878. K.H.

Glycerine and Nitrate Strontia	No change
" " Balsam Copaiva	Reduces little
" " Paraffin	Reduces
" " Silicate Soda	Reduces little
" " Fusel Oil	Reduces
" " Potassic Tartrate	Reduces little
" " Citrate Potash	Reduces
Aniline Oil & Citrate Potash	Reduces little
" " & Picrotoxin	Reduces little
" " & Valerianic Juice	Reduces little
" " & Amygdaline	Reduces little

Dec 17 th 1878 Jno. H. Knight

Dec 17 th 1878 JKK

Aniline Oil & Quinidine Sulph.	Reduces little
" " & Bi Carb Soda	Reduces
" " & Bismuth Lacto phosph.	
" " & Cadmium Bromide	
" " Sulphate Potash	Reduces little
" " Mercuric Nitrate	Reduces
" " Tartrate Potassium	-
" " Fusel Oil	Reduces little
" " Silicate Soda	Reduces
" " Balsam Copaiba	Reduces
" " Nitrate Strontia	Reduces

Dec 18th 1898 [illegible]

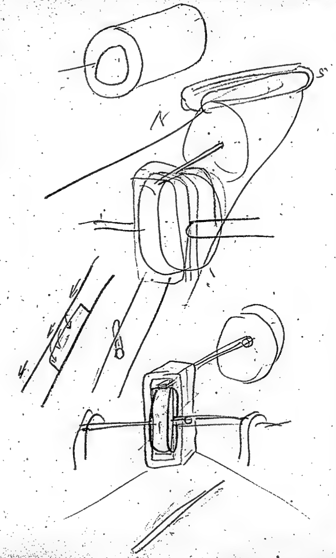
Spectrum Tests continued
Dec 18. 1878 [illegible]

Aniline Oil & Ammonia	Reduces.
" " Sulph Zinc	Reduces little
" " Chloral Hydrate	Reduces little
" " Caustic Potash	Reduces
" " Balsam Peru	Reduces
" " Benzoic acid	Reduces little
" " Tannic acid	Reduces
" " Cochineal	Reduces
" " Carmine	Reduces
" " Dextrine	Reduces
" " Chloride Zinc	Reduces little
" " Glycerine	Reduces

Dec 18th 1878
Jno. Kruesi

Spectrum Test Continued
Dec. 18. 1878 (JKr)

Aniline Oil and Alcohol	Reduces little
" " Valerianic Acid	Reduces little
" " Sness Acid	Reduces li
" " Citric Acid	Reduces little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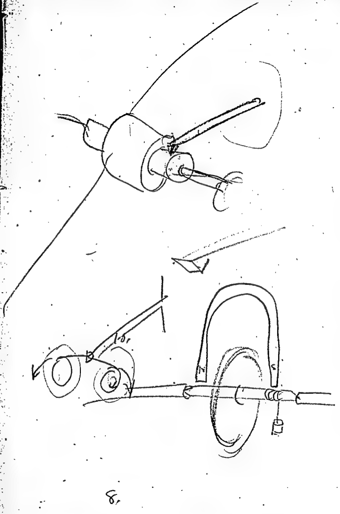

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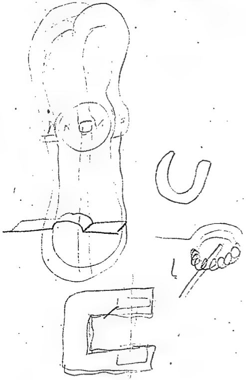

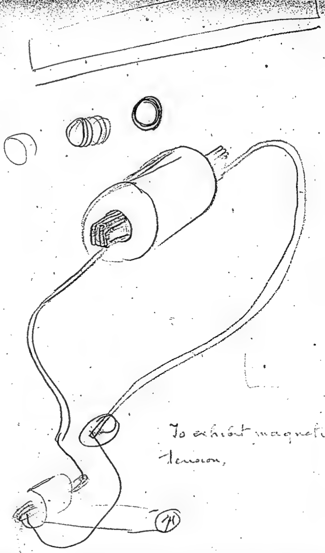

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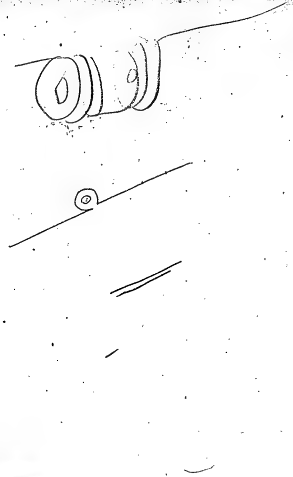

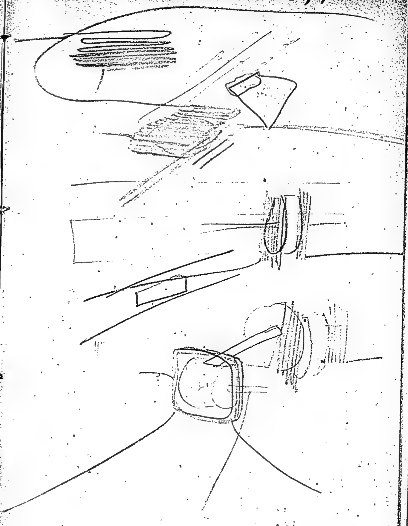

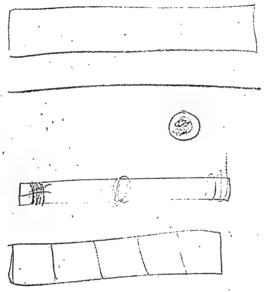

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6" × 14" = 215 "
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10-12 H.P.

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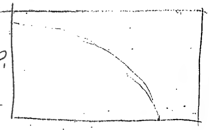

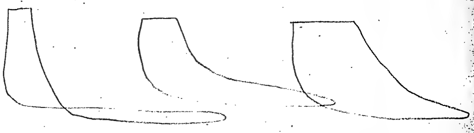

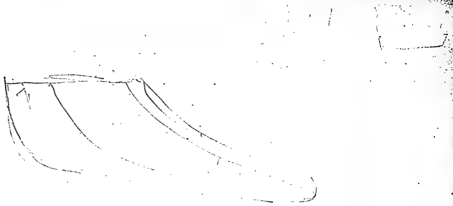

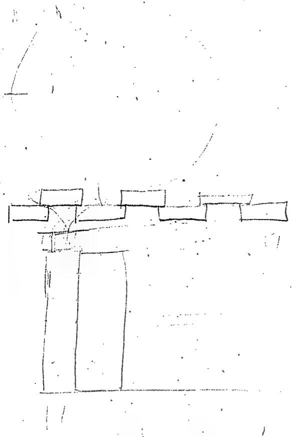

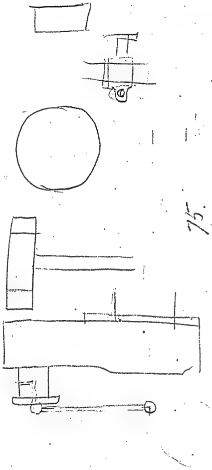

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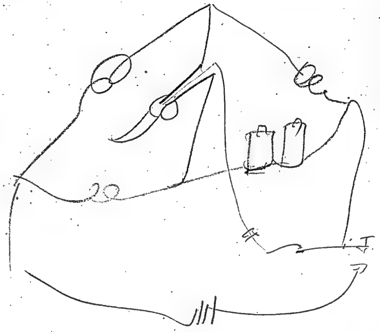

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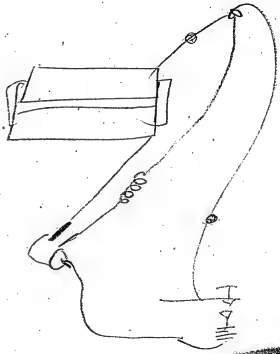

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4576 — End 2 "
4400 End 2 year disp.
359 End 3
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9335 — End 3
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549 — End 4
14284 — End 4
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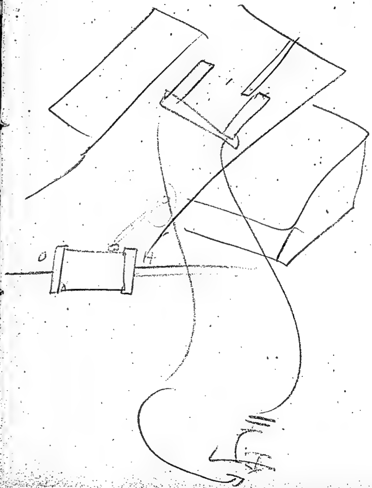

$\frac{1}{3}$

$$\begin{array}{r} 150 \\ 80 \\ \hline 12{,}000 \end{array}$$

Kruzi Esq

$$\begin{array}{r} 150 \\ 80 \\ \hline 12{,}000 \end{array}$$

Kruzi

120

John Kruzi
120

120

Professor John Kruzi Esq

1800

150,

Chicago

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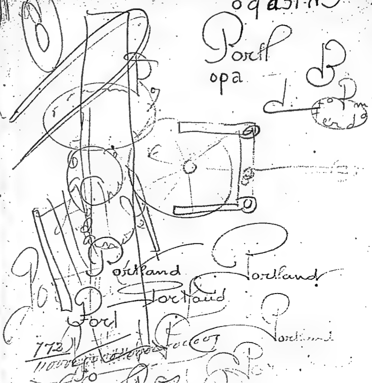

Portland

Portland

Portland

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Portland

772

3.

$$\begin{array}{r} 9 \\ 44 \\ \hline 396 \end{array}$$

44
88

Geo H Bliss

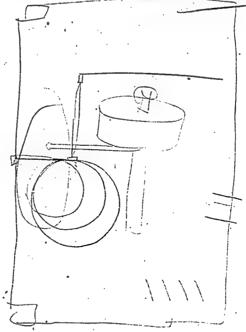
Illinois

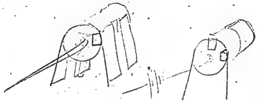
Geo. H. Bliss

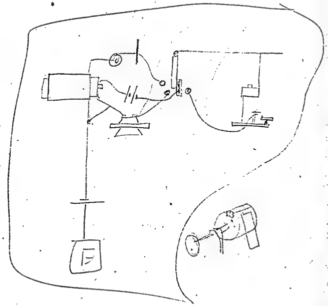
Chicago

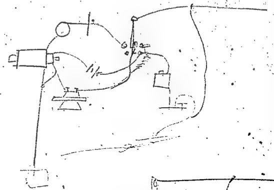
New Receiver Feb 23 1879

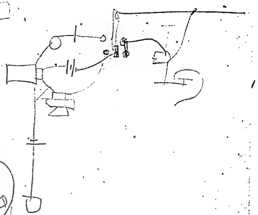
Chas Batchelor

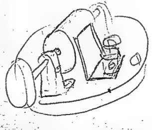






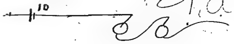


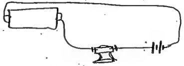


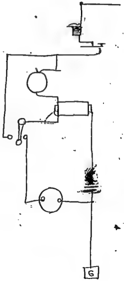


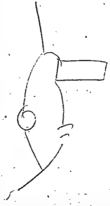
Feby 26, 1879.

T.A.E.









Spiral in vacuum

3-42 P.M. 2 cells
3 51 3 cells
3 55 .. 4 cells
4 00 PM 5 cells
Whiteish very good light
405 6
409 7
414 8

420 10 cells
P.M.
422 11 cells

$3\overline{)26}$

$$\begin{array}{r} 9 \\ 9 \\ \hline 81 \end{array} \qquad \begin{array}{r} 81 \\ 3 \\ \hline 243 \end{array}$$

4½ 2½

$$\begin{array}{r} 6 \\ 6 \\ \hline 36 \\ 25 \\ \hline \end{array} \qquad \begin{array}{r} 45 \\ 6 \\ \hline 270 \end{array}$$

Ohms

$3\overline{)26}$ Volts

$$\begin{array}{r} 9 \\ 9 \\ \hline 81 \end{array}$$

9 Webers

Units of Work Energy

$\frac{1}{1}$ = 1 Weber

$\frac{2}{1}$ = 2 W

$\frac{2}{2}$ = 1 Weber

3564

10.692) 33.000 (3.0 lamps
32076
9240

3300, 1

7370) 33000 (4.6 lamps?
29480
35200

46)100(2 2
92
80

.33 .22

3 | 26 Volts
9 Webers

March 5, 1879.

9
9
81 = 44 ft lbs
81 units of Work
3
243 X 44 ft lbs
44
972
972
3 | 10,692
3.564

4 | 26
6.5

6.5
6.5
325
390
42.25 X
4
169.00 X 44 ft. lbs.
44
676
676
2 | 7370
3685

~~2.979) 10.692 (4~~

29) 1.06 (3.2
97
90

297) 737 (2.4
594
1430

237) 3300 (14
237
930

8 Ohms
10
10 (2.6
2.6 Webers

2.6
2.6
156
52
6.76
16
6.7.6
44
2704
2704
5(29.44
5948
2379.6

1/3

10,000.

3600

1

.4,

6)26.
4 1/3

2 Batter
4

4.33
4.33
1299
1299
~~1732~~
1732
18748 Units
6
11944
44
44576
44576
3)49033.6 Total
1634.45 Batting
2)3268.91 Both Cands
1634.4

114

5) 26
5.2

5.2
5.2
1 0 4
2 6 0
27.0 4
5
20

I can not find the last number of the Experiments but think it was No; 60

March 7, 1879.

Ex. No. 61. ~~Ex~~ Covered spiral with Magnesia from the Acetate. The spiral was brought up suddenly and melted with even fresh cells very acid.

March 16. 1879

We was all night bringing up 12 lamps in vacuum worked all day Sunday all night Sunday Night all day Monday

1 lb Coal 6 hp 1 hour

.10

60) 3393.(56
300
393
360
3

33000

60) 3393.
6

6

1.74

33000) 12000000 (3393
99000
130000
99000
310000
297000
130000
99000
31000

12
30
360

12 lamp 1000 Rivs

1100 revolut

121)   12   11
                  11

$10^2 : 11^2 :: 12 :$ 121
                                   12
                                   1452

14 lamps

1200   17 lamps

$10^2 : 12^2 :: 12$ 144
   12   12
   ~~24~~   1728
   ~~288~~
   146   ~~2332~~

1300   20 lamps
13
39
13
169
12
2006

1400   23 lamps
14
56
14
196
12
2332

1500   27 lamps
15
75
15
225
12
2700

1600   30 lamps
16
16
96
16
256
12
3052

1700 revolution

34 lamps

```
   17
   17
  119
  17
  289
   12
 3468
```

```
 1800
  18
  144
  18
  324
   12
 3888
```

38 lamps

```
 1900
  19
  171
  19
  361
   12
 4332
```

43


```
 2000
   20
  400
   12
 4800
```

48 lamps

```
 2100
   21
   21
  42
  441
   12
 5292
```

53 lamps

```
 2200
   22
   44
  44
  484
   12
 5808
```

58

2300
23
69
46
529
12
6348

63 lamps

2400
24
96
48
576
12
6912

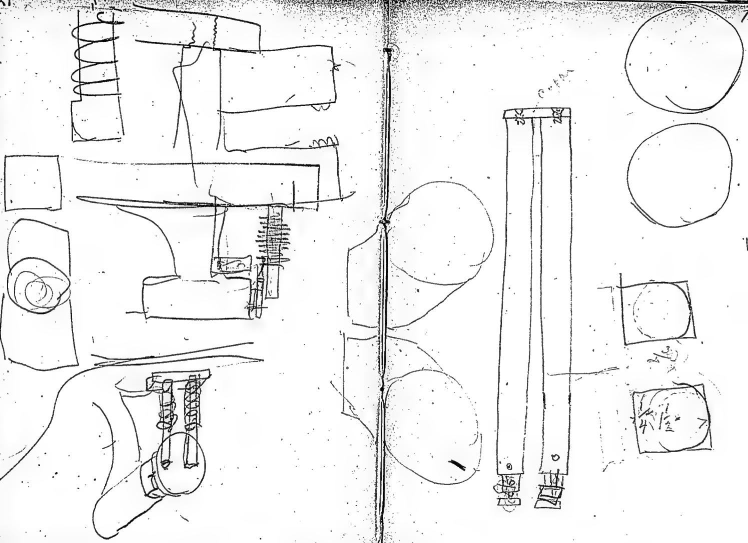
69 lamps

2500
25
625
12
7500

76 lamps

5000
50
2500
12
30000

300



1,140
47
798
456
5358 26.79

Thermopiles

Iron soft = Iron hard - Grey cast iron, white cast iron - casehardened iron - Steel soft = Steel glas hard - Steel to a straw - Steel to a blue, - Steel hardened on the copper end - Zinc ~~steel~~ cast - Cadmium = Tin - Aluminum Lead, brass white = Common brass, composition, Babbitt metal - Nickel - Copper soft = Silver Bismuth, Antimony - Sulphide Lead, Sulphide Tin - Sulphide Iron, Sulphide Bismuth Sulphide Antimony - Sulphide Nickel - Sulphide Copper, Sulphide Manganese, Sulphide Chromium. German Silver - Bell metal = Rose metal - Muntz metal - phosphor bronze, Aluminum bronze = Sulphide Mercury Sulphide Tungsten = Pewter = Brittania ware - Carbon - retort = battery = Carre - Wallace - Coke -

Sulphide Cobalt = Cobalt –
Hyperoxide Lead – Iodide Copper –
Peroxide Manganese – Iron reduced
by Hydrogen = Sodium amalgam.
Potassium amalgam = plumbago –
Red phosphorous =

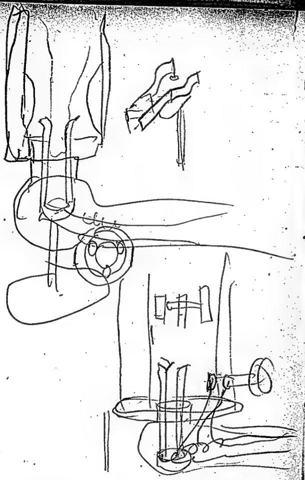
Edison's Telephone June 6th 1879

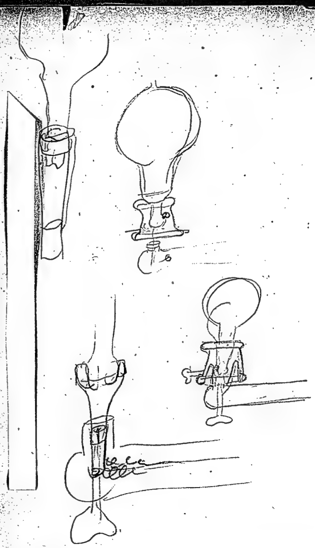
Chas Batchelor

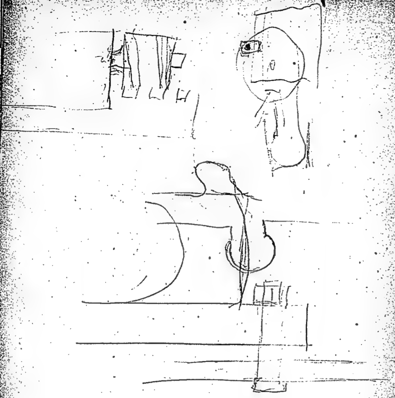
Chalks for Receiver

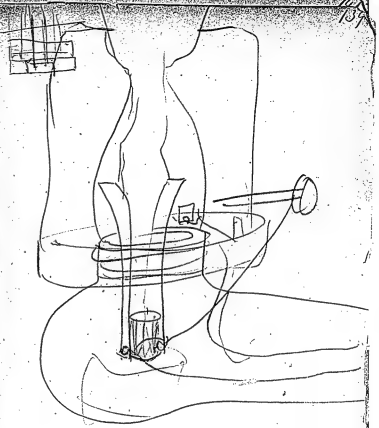
— 12 oz. pp. chalk
— 36 grains Mercurous acetate dissolved in ½ litre water and filtered —
— This solution and Chalk intimately mixed and dried out to thick paste
— Then 2 oz (fluid) of Saturated Solution of Caustic Potash intimately mixed
This was dried & sifted through 100 sieve & pressed

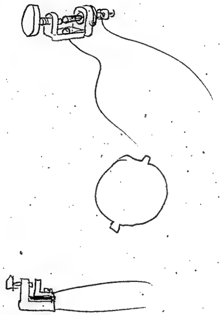
2 – No 1 As much as 3 can press
2 No 2 " " " 2 " "
2 No 3 " " " 1 " —
2 No 4 " " " 1 on short lever
No 5 — very small

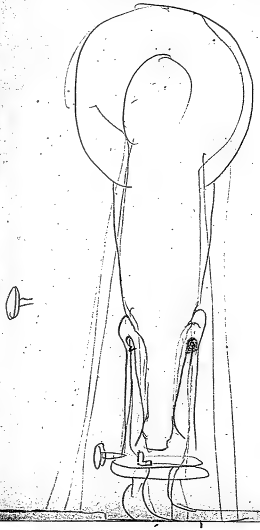












7/8

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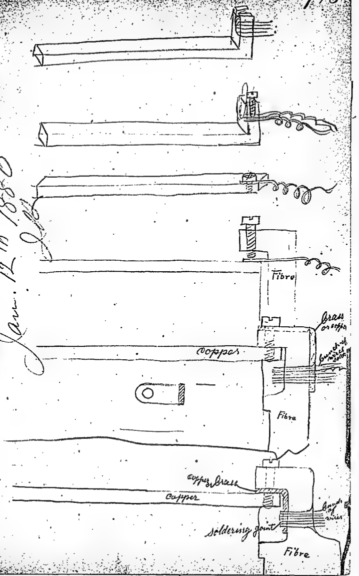
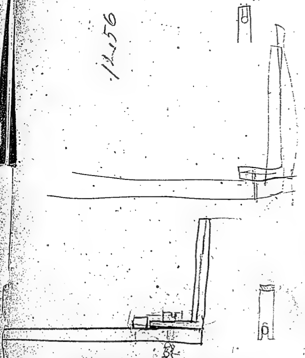
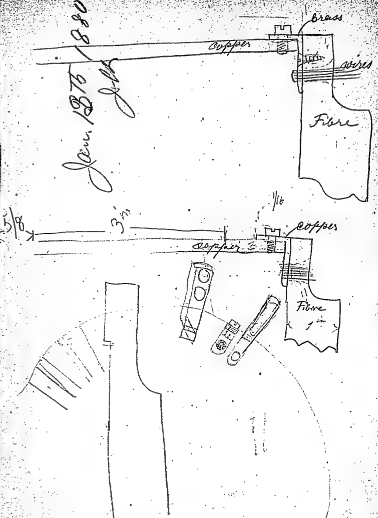
Jan. 12th 1880



12.56



Jan. 1876/1880

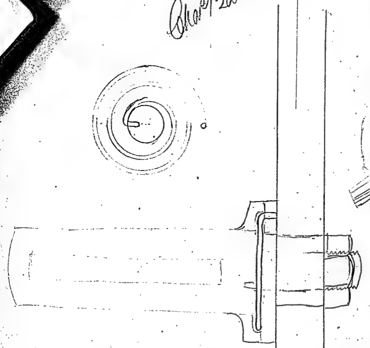


146

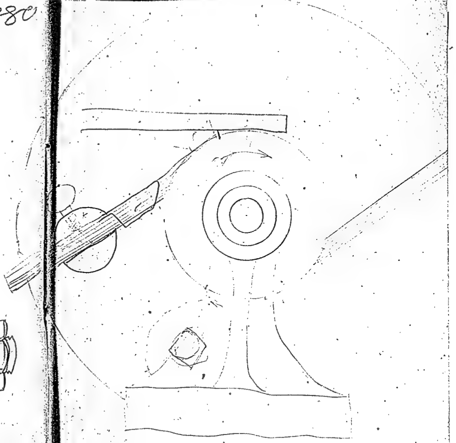
147

Previous to
Jan. 15th 1880

Old Patents



Pages 148 & 149. "Brush Holders."



120
6
1020

18
350
18
170

48
100

195
2
390

18
5
900

322
644
289
49
1529
1124
12769

26
44
58
352
220
2552

184
5
920

54
56
56
128
56
58
128
200
200
32
940

475
1160

394
1
102
158
1419.82
80
240
160
1840
15
9200
1840
27600

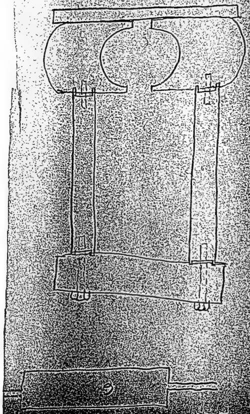
129

	1020	1200
20	2000	3000
112	19—	2800
30	19—	1500
	20	2600
	3	18—
	15	500
	5	150
	3	700
	$11420	3000
		180
		173.80
		114.20
		5400
		1000
		352.00
		96.00
		130.00
		48.00
		31.00
		80.00
		60.00
		36—
		196—
		80—
		276—
		+20
		128

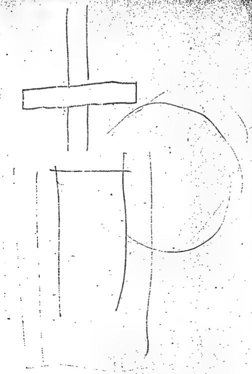
Mo. 20.00
120

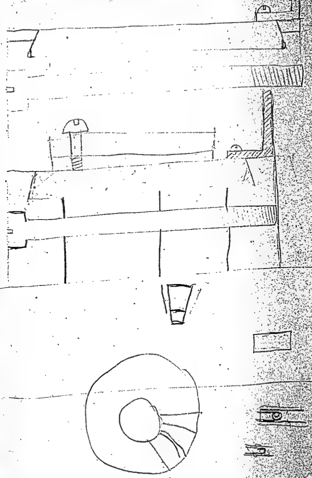
L. $160

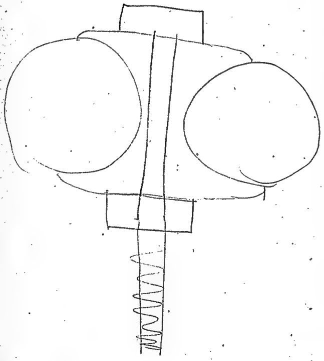
Mo. $ 1653.00
200
$ 1853

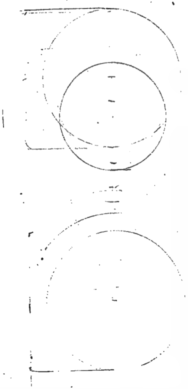


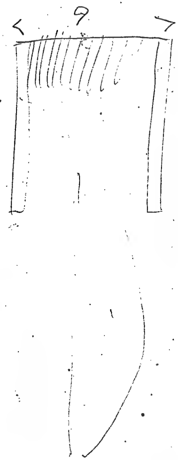
58) 22000 (380
174
460







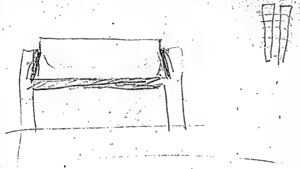




92
43
1/2) 135 = 68

19.68

9.75
9.75
20.68
26.00
65.28
24
2608
1304
12) 156.48 = 1304
75
6520
[illegible]
[illegible]



775 : 280 :: 22000

280
22000
560000
560
775) 616 0000 (8000
6200

125) 30000 (240
250
500

5) 240
4

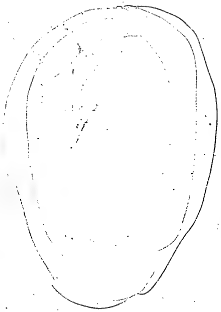
24

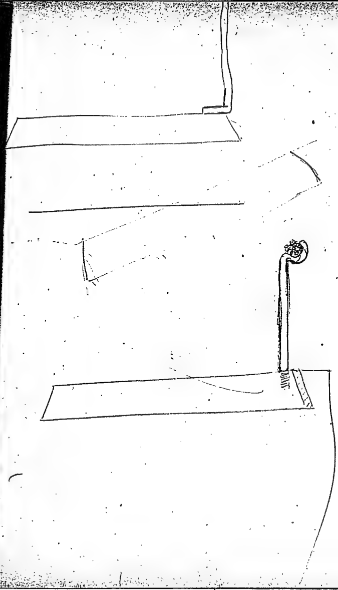
380 3.80

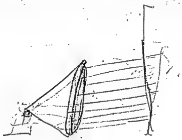
125) 580 (4.0.6
500
800
750
50

22
8800
13200

125) 13200 (105
125
700







For 15, 53.

Portland

A

6

Frodsham

150
50
7500
80
600,000

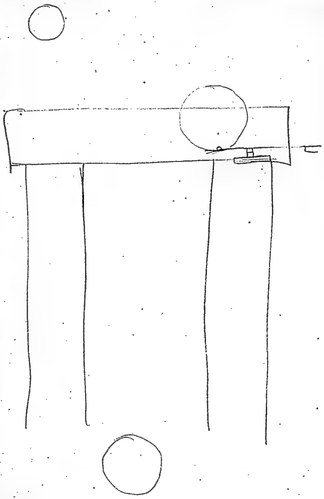
5
55 55 5
120
120

Poy 73 7300 A

150
29
1350
300
4350
588
75
127

15, 34800
34800
387,80
129
127
129
127
129 129 110, 127

168
11.5



$6 \times 6\frac{3}{4}$

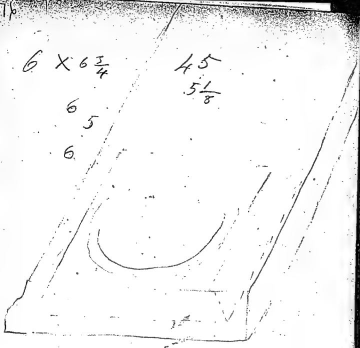
45

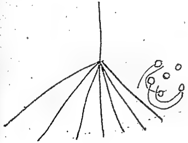
$5\frac{1}{8}$

6

5

6



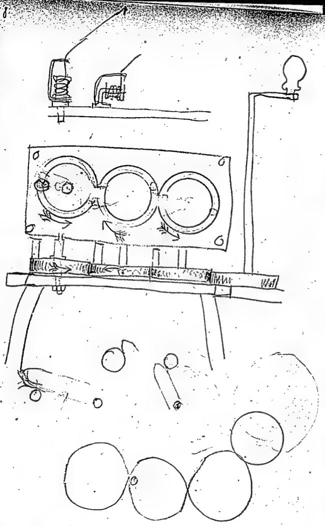


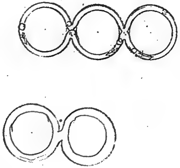
14) 540
90

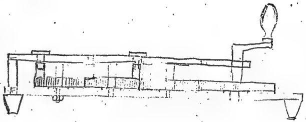
57

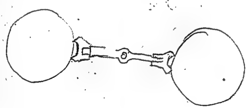
14 8000
70
100
50

14.







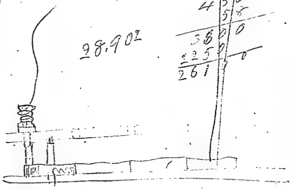


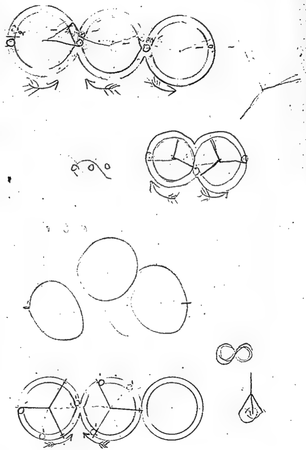
2

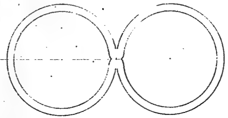
450
60
2700
2700
29.700

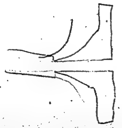
28.902

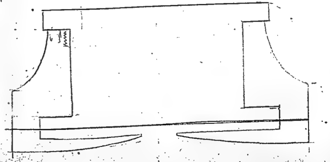
4|5|0
5|8
36|0|0
225|0
261|..











$\frac{1}{2}$

$.25 \quad 6.28 = .251$
128
30

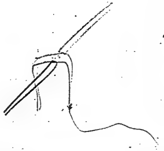
$4\overline{)6.28} = 1.32$
2

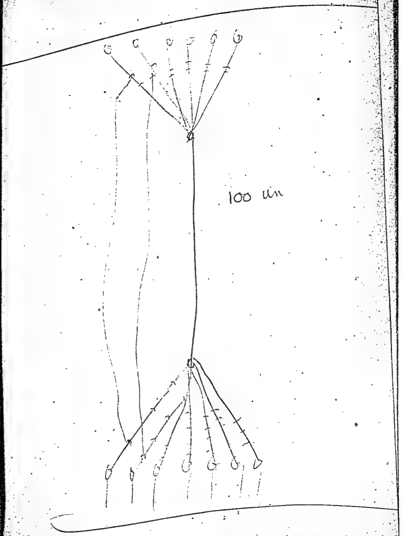
$6.\frac{1}{3}$

$6\frac{1}{4}\ 4.25$

$= .251$

$25 \quad 25\overline{)628}$
$.128$
30





.025) .054 (2.16
1.050
40
25
15

012
2.4
.0096
4.6
576
384
.04416

.054

.012 candles face

16.0
1.4
4.6

~~54~~ : ~~44~~ ::
27 22
12
44
22
27) 264 (9.8
243
210

~~3/6~~

50
300

.032

3.025
.032
6050
9075
.096800

2.65
1.325
3.975
.17
27725
3975
.67475

3.975
.674
3.301

~~1/3~~
25

$$R = \frac{l}{d^2}$$

33 000

$$\frac{\begin{array}{r}16\\7\end{array}}{11.2}$$

Arithmetik $\frac{1}{}$ $\frac{1}{3}$

8, $2\frac{1}{2}$

7

$1\frac{1}{2}\frac{1}{3}\frac{1}{4}$

1	10	$\frac{1}{2}$		
2	5	$\frac{1}{4}$		
4	2	$\frac{1}{2}$	$\frac{1}{8}$	
8	1	$\frac{1}{4}$	$\frac{1}{16}$	
16	$\frac{1}{2}$	$\frac{1}{8}$	$\frac{1}{32}$	

$\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$

$\frac{1}{4}$ $\frac{1}{4}$

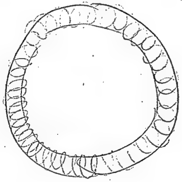
$\frac{1}{4}$

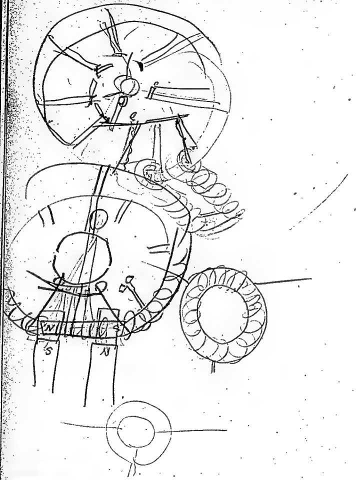
$\frac{1}{16}$

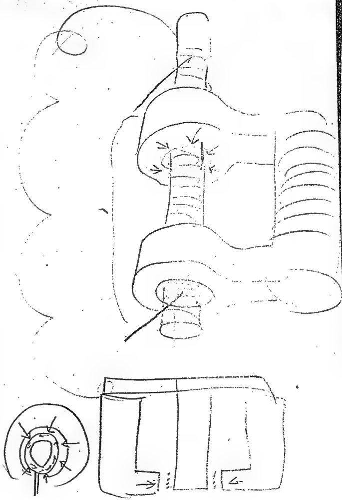
20.

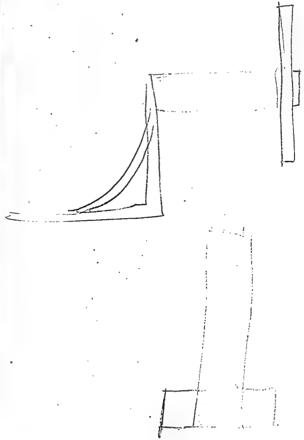
$21/32$ [illegible]

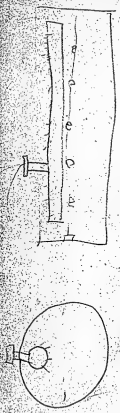
[illegible]

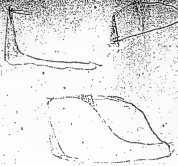



N
S
S
N









Menlo Park Notebook #4 [N-78-12-04.2]

This notebook covers the period December 1878-April 1879. Most of the entries are by Edison, Charles Batchelor, and Francis Upton. There are also entries by John Kruesi, John Ott, and George Jackson. Almost all of the material relates to experiments on electric lighting. There are drawings of lamps, including vacuum experiments; drawings of a machine for insulating spiral filaments; and notes, drawings, and calculations about generators, with a series of numbered experiments cross-referenced to other notebooks. There are also notes by Upton taken from a work by John Tyndall on heat; drawings of telephones; drawings of a blowpipe and of a microscope table; Kruesi's notes on work done to the laboratory buildings; and a memorandum by Edison on scrapbook titles. The book contains 282 numbered pages followed by one unnumbered page.

Blank pages not filmed: 114-115, 164-165, 220-245, 248-279.

Missing page numbers: 143-144, 161-162.

No. 4

BOARI

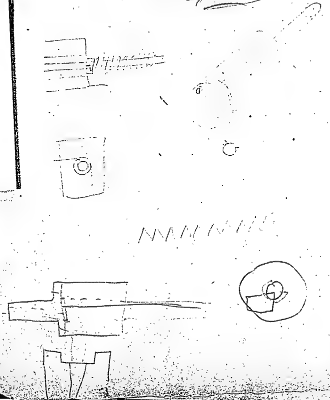
Dec 4 1878 1

Electric Light.

Chas Batchelor
J Kruesi

Machine for filling spirals with insulating substance.

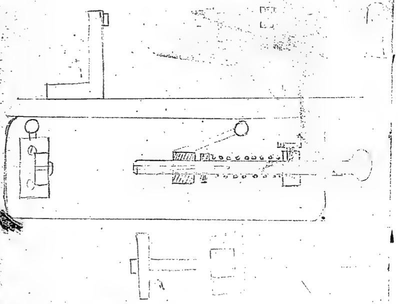
Made by Jackson



Electric Light Dec ~~4~~ 3d 1878

Chas Batchelor

Instrument for pressing spirals under heat



Made by ~~[illegible]~~ 13.

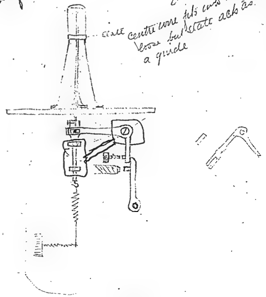
Dec 4 1878

Chas Batchelor

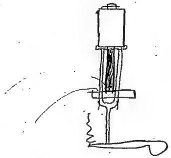
J. [illegible]

Made by John Ott

Electric light Regulator



centre wire fits into slate loose but slate acts as a guide

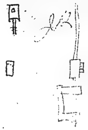


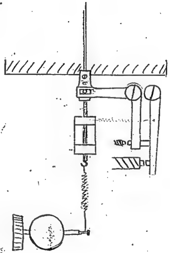
Electric Light

Dec 5th 1878

Chas Batchelor

New Regulator

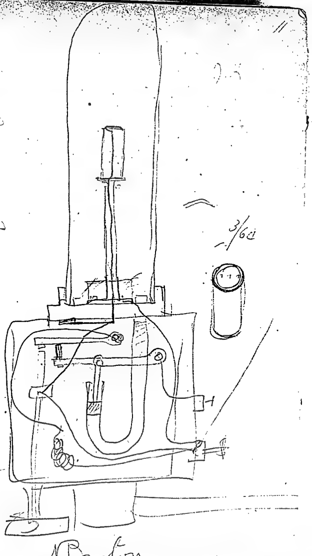




Regulator

John Ott

3/60

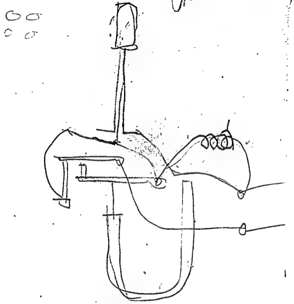


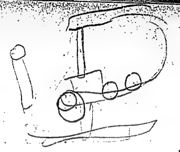
N Boston

Regulator

Dec 5 1878

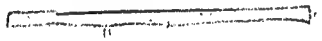
Chas Batchelor



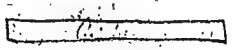


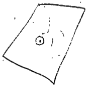
6/50,

1.,



1/8





3/8 x inch., 1 ohm, . 1 h.p.
1/4 . . 6. hp
10,

Portland,
Portland.

Portland Portland Portland

16

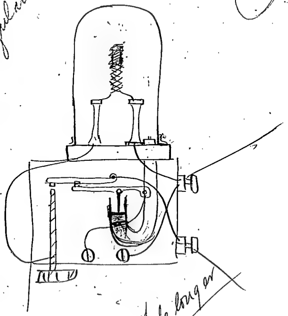
Electric Light

Dec 10th 1878 17

John F Ott

Chas Batchelor

Regulator



Tube longer

Electric light Dec 10 1878. 19

Pneumatic Regulator Chas Batchelor

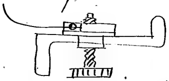
John F Ott

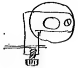
John Ott

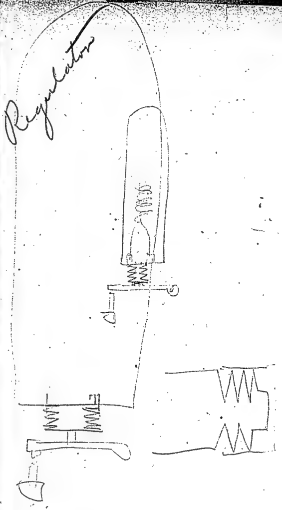
Fasten the

lever link to diaphragm permanent as the heat softens the wax and lets it come loose.

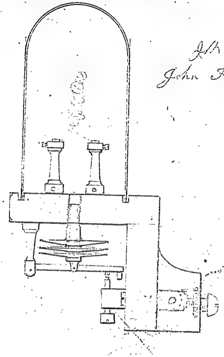
Insulate the adjusting screw so: And fasten the wire to it






Regulator

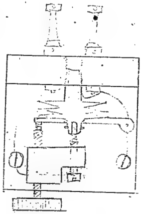
Regulator



JFO
John F Ott

E.L.
Regulator

J.K.
John Ott



Titles of Scrap books,

Electric Light.

magnetomachines
Lamps
Carbons
Photometric tests.

Magnetism, of Steel bars.
Researches Connected therewith.

Electro Magnetism

All researches on Electromagnets

Induction, (Magnetic)

Induction, Static
of Condensers - plate glass machine

Polarization, including
Secondary batteries,

Galvanic battery,

Thermo Electric Currents.

Conductivity & Resistance
of Matter,

Telephone,

Telegraphy, Fac Simile,

Telegraphy. Duplex Quad.

Telegraphy Automatic,

Telegraphy. Fire alarm
Burglar alarm

33,000
600
19,800,000
2,086,000

$\frac{1}{10}$

60
10

Horse Power man's power
10 hours
19.800,000 per day [illegible].

Man lifting himself on ladder.

2,088,000

2.088) 19.800 (9.
18792
0008

Man $\frac{1}{9}$ Horse power raising his own weight.

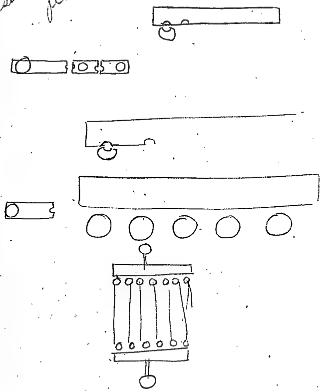
Turning crank or wheel
1,296.000

1.296) 19.800 (15
1296
6840
6480

$\frac{1}{15}$ of a Horse power in turning a crank of a machine.

Resistance coil, plan of

15
12
180



~~1~~ inch = 1 ohm G.S. Wire

.016

$21\frac{3}{8}$

.016 Dynamo Edison figures for

Copper = 24.8 feet per ohm

G.S.W. 15.47 times resistance

154) 24.8 (1.61
15 4
9 40
9 24
160

1.61

8) 61
$7\frac{5}{8}$

11) 24.8

~~11~~

~~GS~~ German Silver Wire

.016 when drawn to double its length is

$11\frac{1}{2}$ inches to 1 ohm

A piece Vulcanized fibre
made accurately

5" long
3" wide
$\frac{1}{8}$" thick

Put in water (Boiling) 1/2 hour

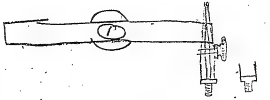
$5\frac{5}{64}$ long
$3\frac{5}{64}$ wide (scant)
5/32 thick

or 5.08
3.07
.15

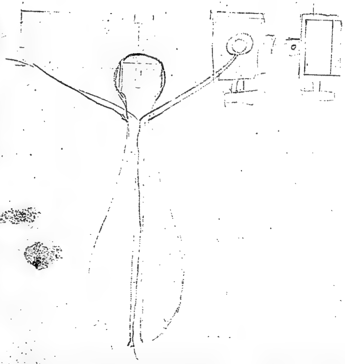
When cold & dry =

when wet & hot 5 3/16
" cold & dry 5 3/64

For holding wire.



3½



188
22
376
376
10 | 4136 | 413

22 | 1880 | 85
176
120
120

413·6
18 | 5744 | 321·71
22 | 4136 | 188
10 | 9099 | 909·92

413·6
22 | 4136 | 188

Variable counter shaft

Main	Counter		Speeds of counter
22	22		413·6
18	18		241·71
14	14		146·22
10	10		85·00

Counter

413·6 =

22 = 10		909·92
18 = 14		531·7
14 = 18		321·7
10 = 22		188·6

241·71

22 = 10		531·7
18 = 14		310·77
14 = 18		188
10 = 22		110

146·22

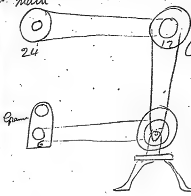
22 : 10		321·68
18 : 14		188
14 : 18		113
10 · 22		~~10~~ 63·75

85·

22 · 10		187
18 · 14		109
14 · 18		66
10 · 22		36

This is bad as it gives unequal speeds

Speed) Countershaft
Variable



Main 188
Counter 376

22 X 10
16 X 16
10 X 22

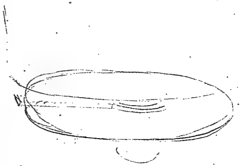
give three speeds on Gramme machine

2068 rev
940 rev.
428 rev

Counter # 376 = ~~Old~~ Machine

Second Counter 15 X 6

22 X 8 =	1034 =		3102
20 X 10 =	752 =		2256
18 X 12 =	565		1695
15 X 15 =	376		1126
12 X 18 =	251		753
10 X 20	188		564



Laboring work

Wrap water pipe from Cistern
To pump

To dig for setting the Soap
Kettle & to get to all the
pipes.

fill in dig for water pipe
" " " To pond

Dig trench for new office
and for water pipe "
Bank up around Laboratory

Carpenter work

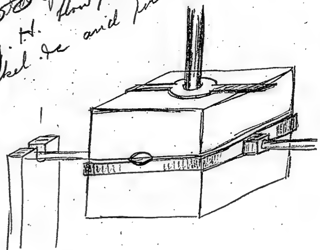
Put in a new Door in middle room
on South side

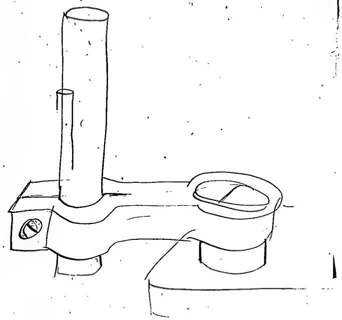
Take sheeting on Front off & put
Tar paper under

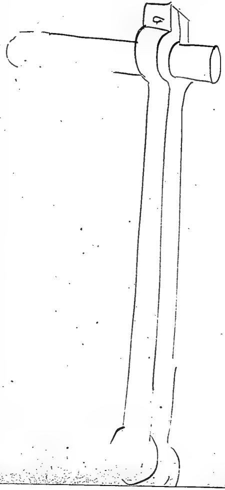
Table for Shop

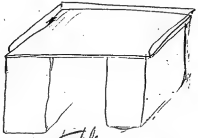
Put in new sink up stairs

~~[illegible] making~~
Obj. H. Blow pipe to melt nickel &c and pour in moulds

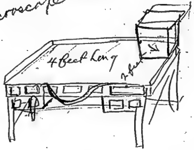








Microscope table.



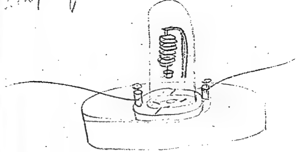
drawers 1 foot Long
3 inch deep!

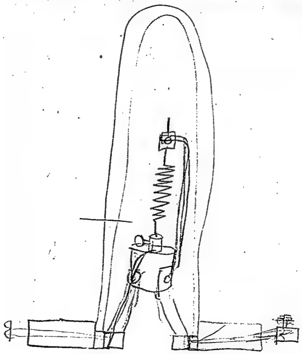
Covered with smooth Green Oil Cloth

67

Protochloride

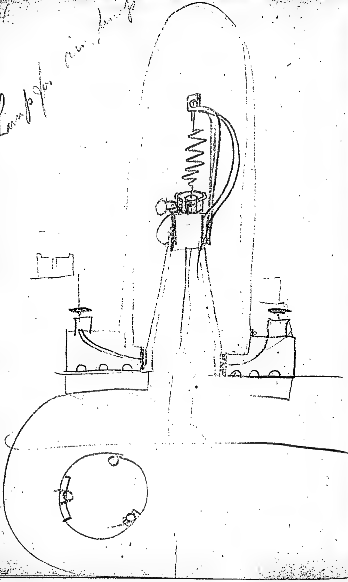
Lamp for air pump



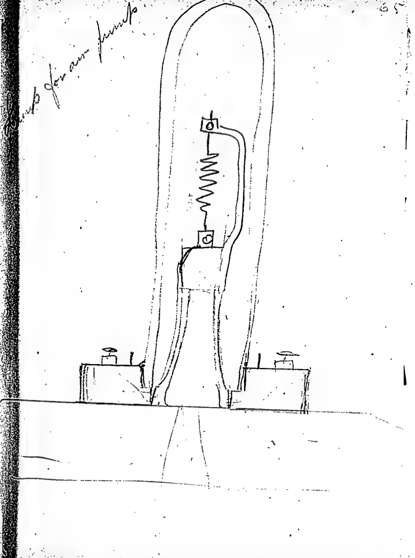


Lamp for Air pump

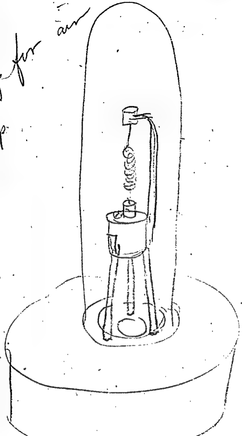
Lamp for air pump

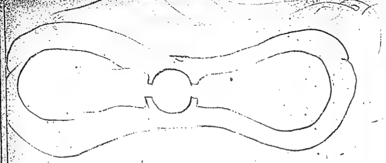


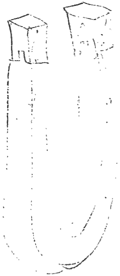
Lamp for air pump.

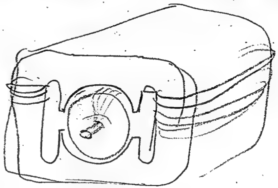


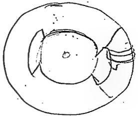
Lamp for air pump











1

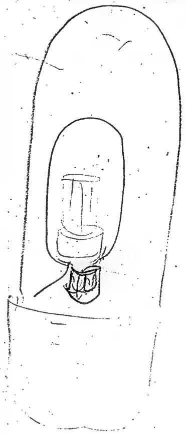
32 20 100

46
4
184
44

8096.

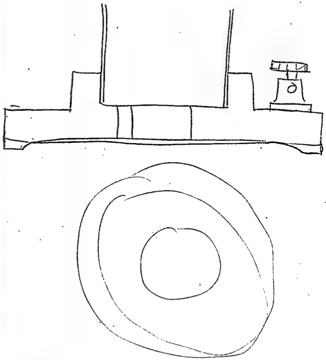
1.50
8
12.00.

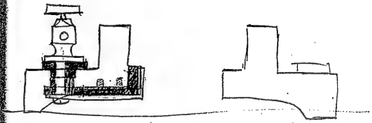

3700
n
10

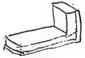


72

73







76

Edisons Magneto Electric Machine Feb 15 1879 77

Exp. ~~to get the current out of it~~

Book No. 34 Chas Batchelor

Page: 77 to 159!" Dynamo Notes, Sketches."

Unimportant.

side and commutator moved round a little each time

There is a slight cross between coils 0.7 and 0 8

Found this and got it out

The wire that comes through the groove from armature had worked out and was wedged in between the fibre and the shaft this must be covered in next by hard rubber shell as I have done this

Over

Feb 15 1879

Edisons Magneto Electric Machine

Exp. ~~to get the current out of it~~

Exp No. 34 Chas Batchelor

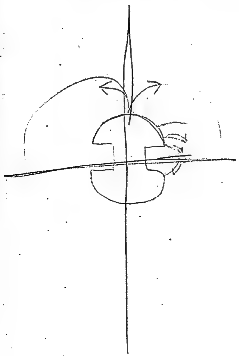
8 springs connected together on each side and commutator moved round a little each time

There is a slight cross between coils 0.7 and 0 8

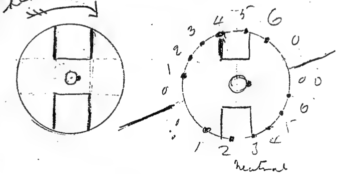
Found this and got it out

The wire that comes through the groove from armature had worked out and was wedged in between the fibre and the shaft this must be covered in next by hard rubber shell as I have done this

Over

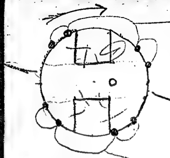


Exp. 1
The pole is 90° from where drawn



Current quite strong in the commutator

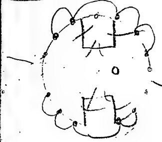
Experiment 35
3 + 4 taken off on each side



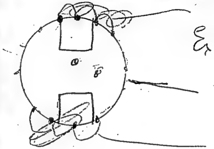
Ex No. 36

No current

Ex. No. 37

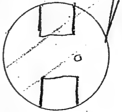


Current



Ex. No. 38

Ex. No. 39

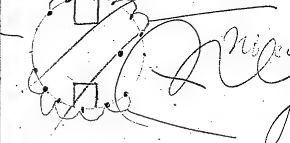


Connected the fixed commutators together so that there are four coils two and two all round

four off of the coms on one side & only 2 on

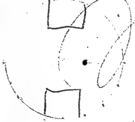
ncf

Ex. No. 40.



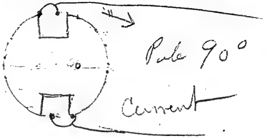
Misalignment

Ex. No. 41.



Commutator sparking off

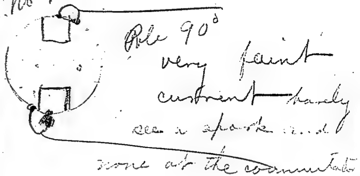
Ex. No. 42 Fixed Com 2 & 1



Pole 90°

Current

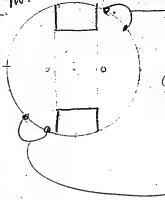
Ex. No. 43



Pole 90°
very faint
current hardly
see a spark and
none at the commutator

750 revolutions

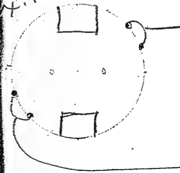
Exp. No. 44 242



Pole 90°

No current

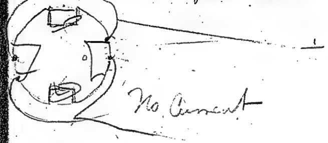
Exp. No. 45



Pole 90°

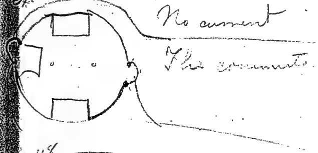
No current

Ex. No. 46 2 + 2 fixed Comm.



No Current

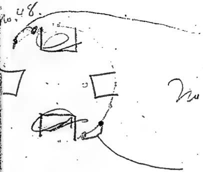
Ex. No. 47



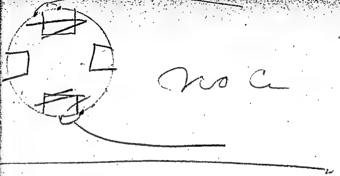
No current

The commutator [illegible]

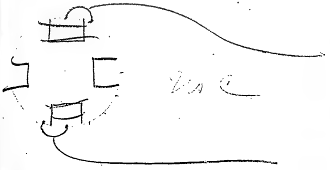
Ex. No. 48.



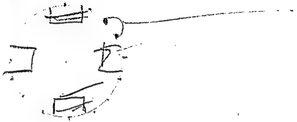
No Current

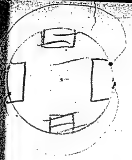


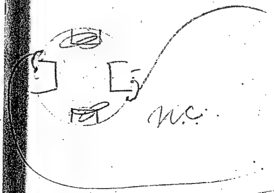
no C

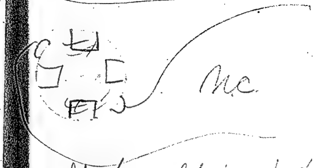


no c



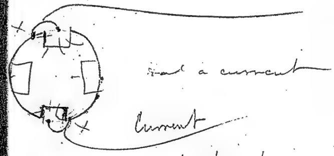






A Shock could be got from
the iron to the insulated core

Tried various movements about this so as to get Ex. [illegible] 2 Tested with current using a sounder, found cross between one of the coils and the base.

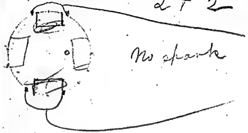


X Last one of the pair ... all the five, was the only one burned.

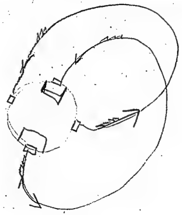
98

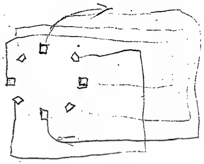
The one wh. breaks the circuit gives the spark.

2 & 2 99



Connected four and four
four fours.





102

Battery put on the armature 103

Coils connected
four and four

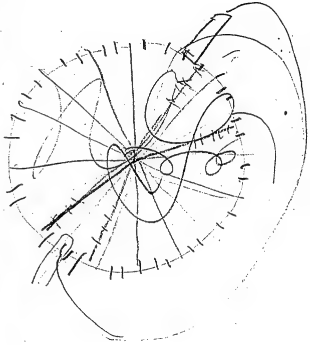
Current through
the commutator for
the most part. The tension
was extremely high as
sparks could be allowed
through the body as a resistance
very slight

No. 50
The fixed commutators were fastened in groups of eight and the wires brought to the outside from them. The Gramme machine was then used to run the magnet and a fearful polling was the result as nearly all the currents were short circuited. The sparks on the commutator were very large

No. 51 One day of the fixed commutators used and a small arc obtained from carbon tubes.

Ex. No. 52 Feb. 16 1879

With one man power, Martin,
a fair arc could be obtained
from carbon points. A foot
of .001 Inch Pt was heated
The commutators were connected
so that the current ~~was~~ had to pass
through four coils. Large sparks
were obtained outside the battery being
used to make the field magnets.



115

Ex. 53. The battery current 111
was put from the top ~~and~~ to
the bottom commutator ~~and~~ piece
of the Gramme and the ring
removed. The current is very
little from the sides. Perhaps
if the battery current were sent
through a different coil
it would work.
For diagrams of possible
connections [illegible] some [illegible]
possible ones [illegible] the
Dynamo machine [illegible]

Book 7 169-175
9 181
28 1-81

Plan of Electric Lamp
Book 9 175

Tyndall estimated the heat given off at whiteness as 22 times that at below red heat. "Bugs" The radiation from the glass would interfere probably he raised the temp. from low red to White & when white had the radiation from the glass to account for. Therefore there is a much larger amt of heat stopped by the glass at red heat than at White

figured on figure from Prof Barker

full horsepower is

Capable of it could be

turned all while

Electricity of producing

a current which

ohms has equal to

730 Daniel cells

in a resolution of

730 ohms (Internal & External)

---

1 weber = 42 ft lb

Feb 16 1879

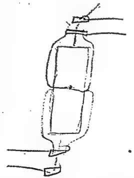
40) 33000 (8
2

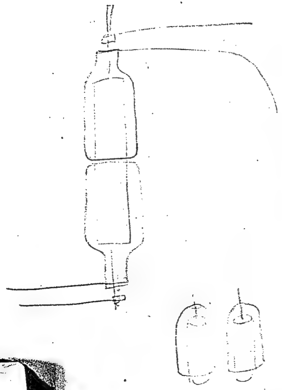
730.

Faraday

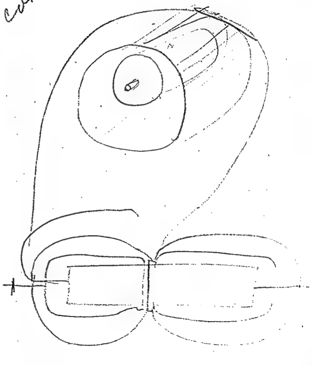
2.

730
60
43800





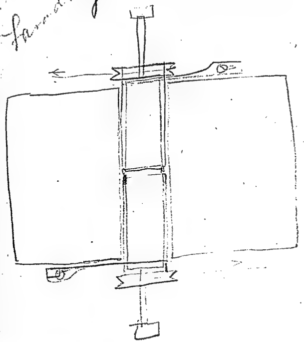
attempt
No commutator machine

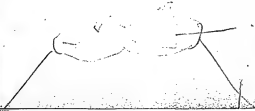


120

Feb. 19

Faraday

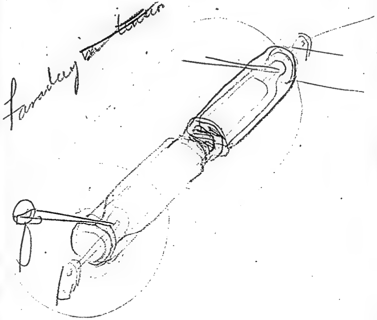




Feb. 19

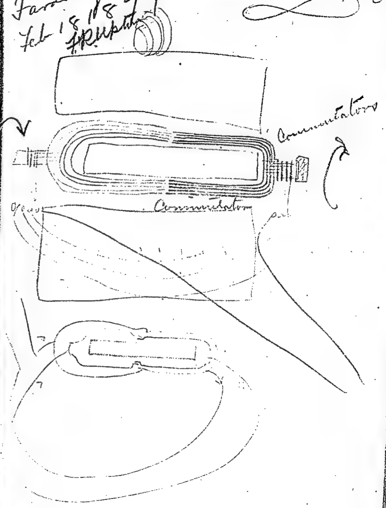
121

Faraday



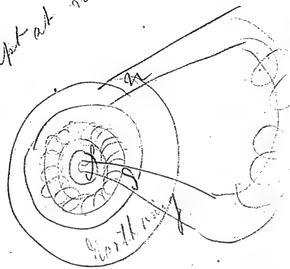
123

Faraday machine
Feb 18 1879
F.R. Upton

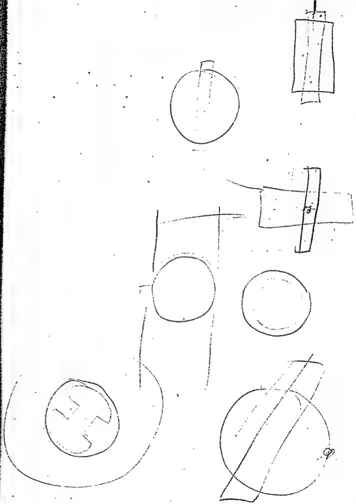


124

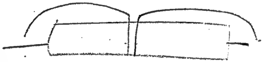
Attempt at no commutator

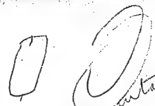


125

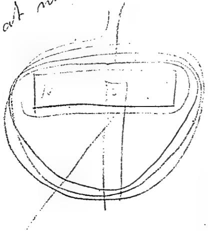


Faraday

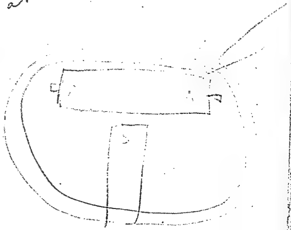


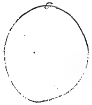


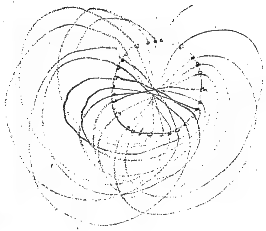
attempt at non commutator



attempt at non commutator

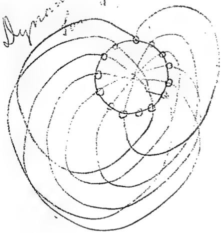




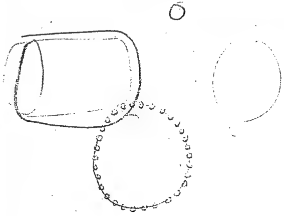


132

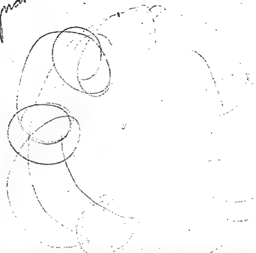
Dynamo für starke Ströme und [illegible]



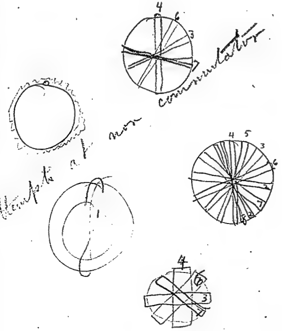
133



Dynamo

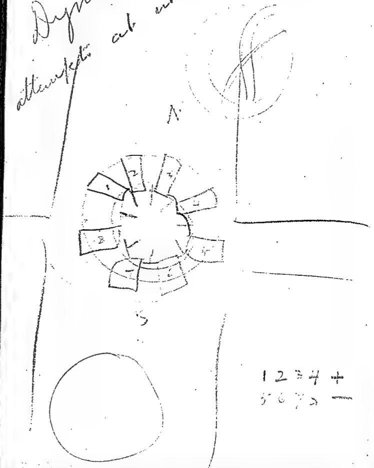


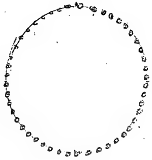
attempts at non commutator



Dynamo mach—

attempts at non commutator

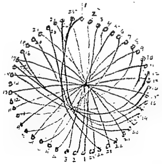


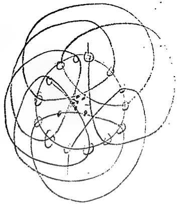


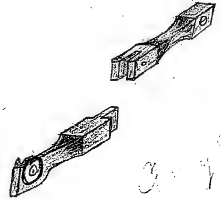
47.

5

Dynamo commutator

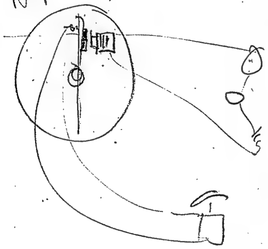


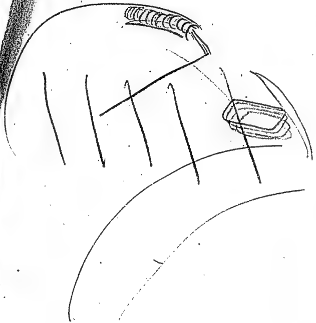




Slot wants to be cut opposite way ~~for~~ as shown in drawing

Dynamo Machine
with magnet





Feb 19 1877

Ex. No. 53 Tried to link up the 16 commutators into seven groups. Did not succeed. See Book for diagrams

Ex. No 54 Made seven new commutator plates for over the old

Ex. No. 55. Put the current from the Gramme into the magnet of the Edison and found that the magnet turned much harder.

Ex. No. 56 Put the current into the magnet of the Gramme and found one place where the ring turned a little harder.

Ex. No. 57 The current passing through the whole machine gave a strong pull. The hand on the shaft could turn it the other way. Seven cells of battery used, each connected in series.

Feb. ~~19~~ Ex. No. 58

~~I tried not~~ Mr. B— tried mixture to close glass to a brace case—

For drawings for glass case see

Ex. No. 59 Feb. 19

Tried Dynamometre. Found that there was too much friction on the spring. For plan of dynamo-mometre see

~~wanted~~ Mr. E suggested a [illegible] spring. Then that a magnet be used to drag the bar with it, and the current ~~broken~~ switched at the time [illegible] the bar freed.

Ex, 60

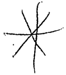
The battery put on Gramme and ~~the~~ ring run. Three iron wires heated four feet long. When the Gramme ran its own field three wires very hot, two not as hot and one barely red.

Ex. 61 The Gramme used to run the field of the Edison a ~~[illegible]~~ very strong drag on the belt was noticed when the current was put on.

140
21
140
280
12)2940 (241
24
54
48
20

2
482 ft

ask to move



Ends 189
5
12)945 (79 ft
84
105

|||||| 34 ft

Feb 20 ~~C. Steele the Edison~~

No. 14 .83

5 Armature Edison wound
5 drawn

5

4.97
3.15

3.15
5
.083)15.750 (189
83
745
664
810

18.9
21
189
378
12)3969 (330
36
36
36
9

330 ft of wire
1/2 Ohm

 Wire 75 Ohm

Resistance Gramme

magnet .75 Ohm
ring .60 Ohm

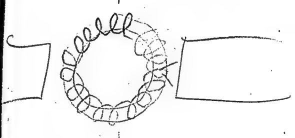
Wallace

16.7
.75

Total 16 Ohms

3.3
.75
2.65 Ohms

Feb 20 1878

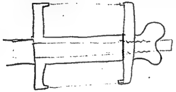


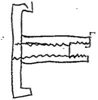
A Gramme ring could be made with one side open, this side could be used for Jablochkoff the continuous side for making the field magnet. E

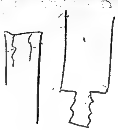
160

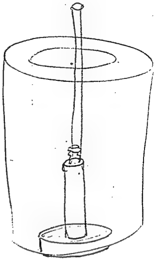
168

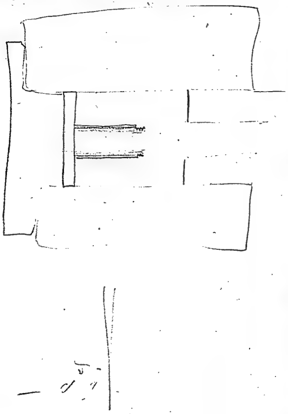
Pages 163 to 175. "Telephone Sketches." Unimportant.

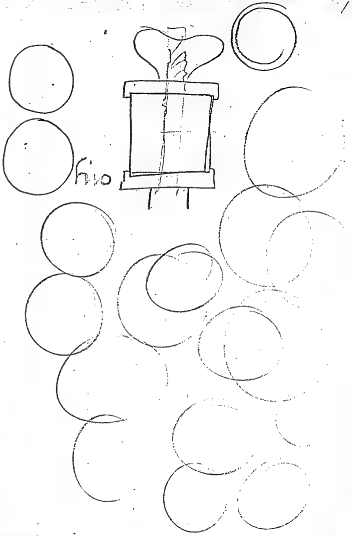




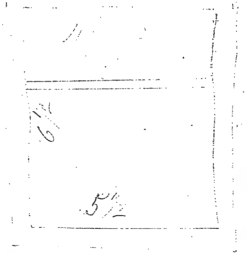


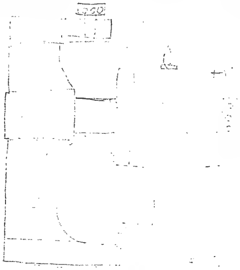





Fio

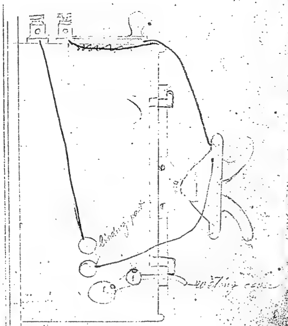
Ohio Round Writing


6¼
5½



Electro Motograph Telephone

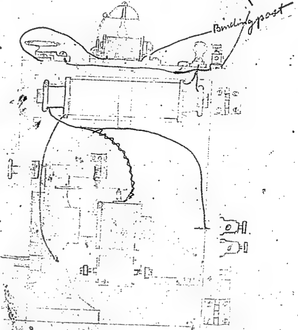
Feb 24th 1879

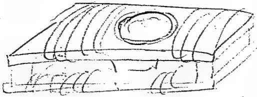


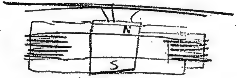
Electro motograph Telephone

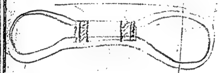
Feb. 24th 1879

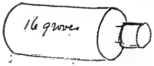
J.K.









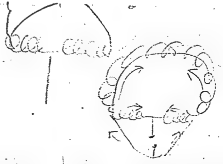


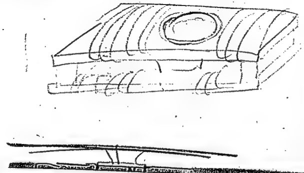
Edison Laboratory Note Book No. 4.

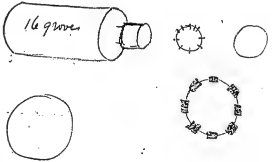
Pages 176 to 181.

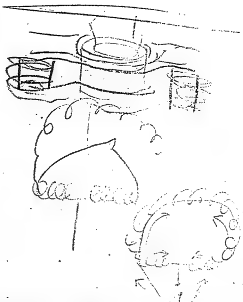
Dynamo Machine Sketches.

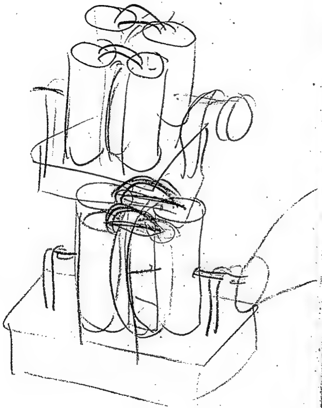
See Edison Patent:
319,393

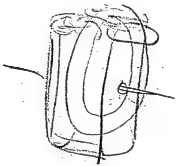


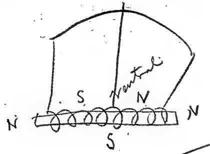


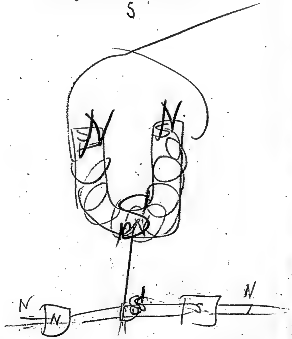

16 grooves

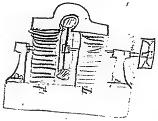


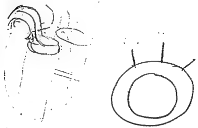


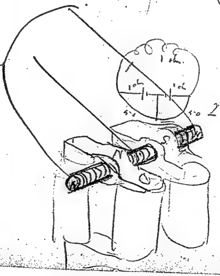






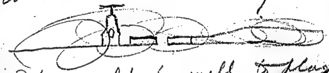






9439
6087
2172) 155–5
13034

The binding post must be placed as near as possible to the connecting post and the wire fastened to the other connecting post.



It would be well to ~~place~~ place the binding post in the place of the screw next to the connecting block

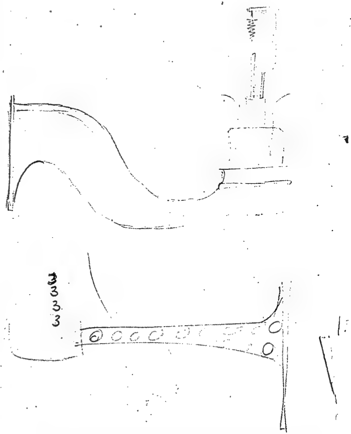
Only one binding screw needed, a hole should be made under it in the wood

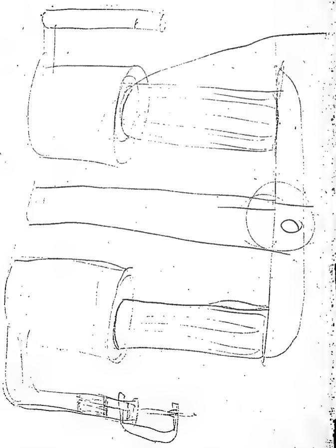
Pages 182 to 185. "Old Resistance Boxes extencively use

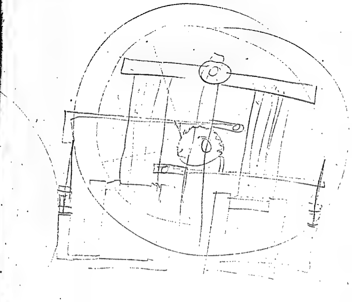
Put binding post in screw hole next to the connection block A. Attach wire to other block B.

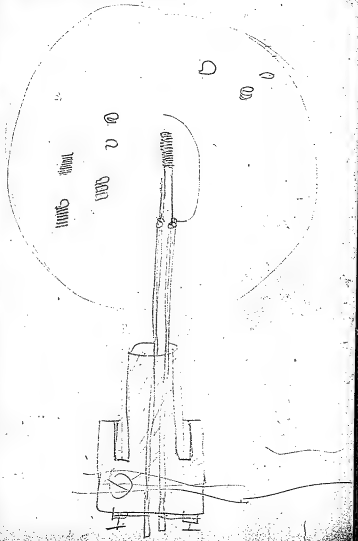
One connection screw C with a hole under it

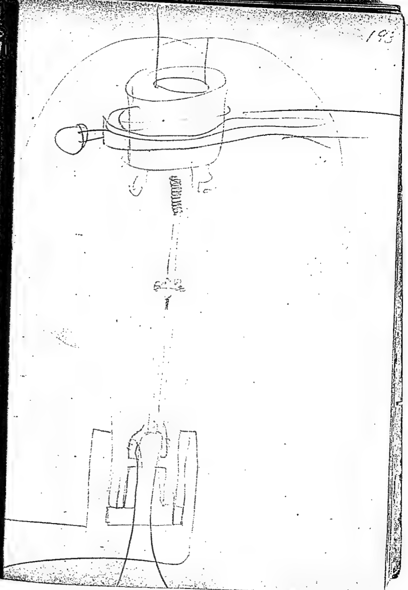
~~Wire from other screw~~ to a large copper pin ~~smaller wire over it~~


3
3
3
3

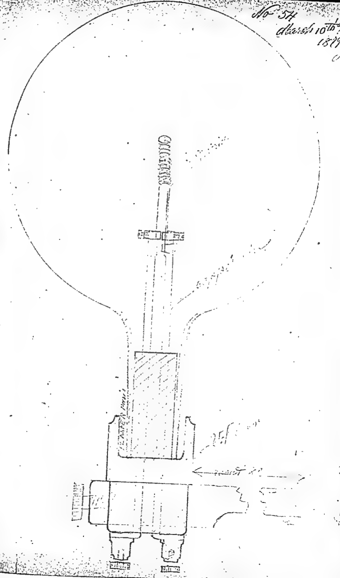


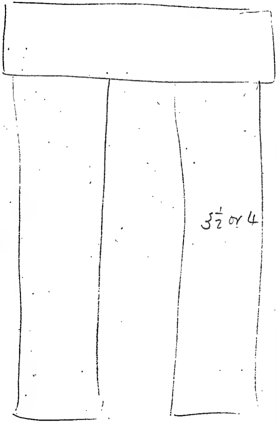






No 54
March 10th 4 5
1879
J. K.



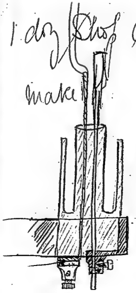

$3\frac{1}{2}$ or 4

80
20
20
12

40
161
48
46
81

1 doz Shop lamps

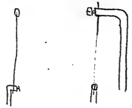
make

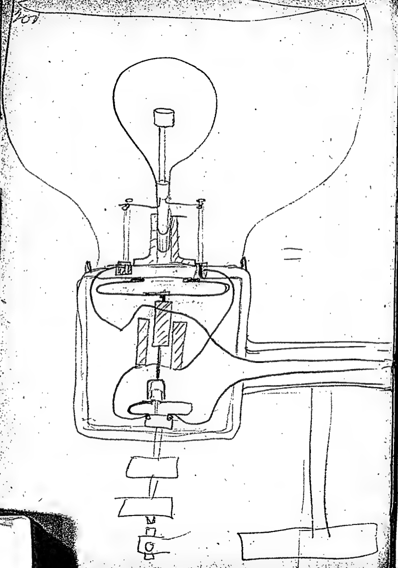


.020

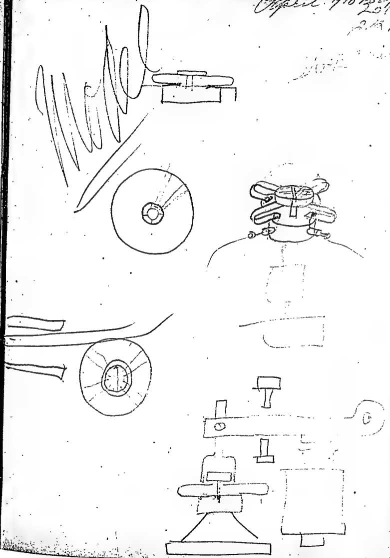
.02
36 311 4

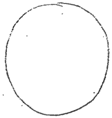
3 7/16 .0625
.4375

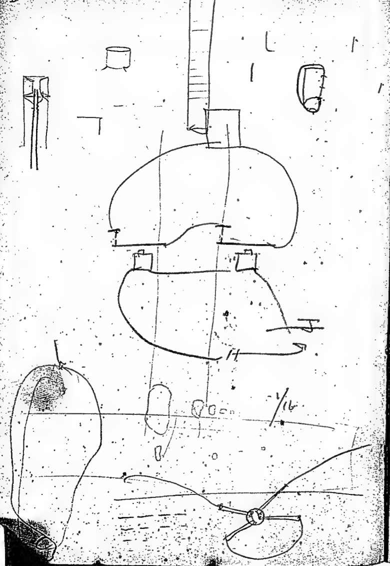


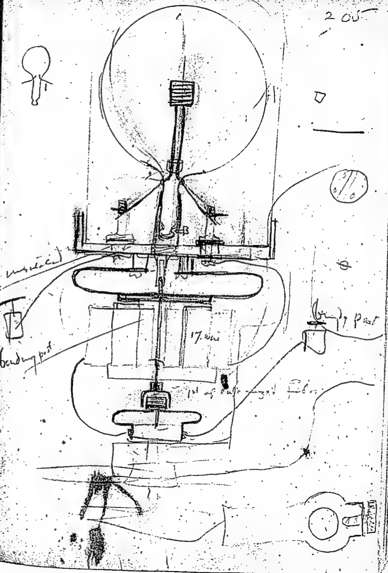


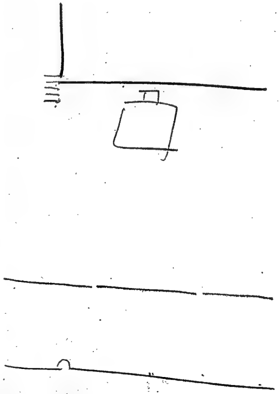
2.A.

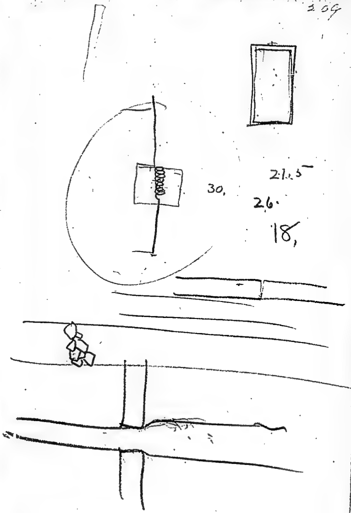


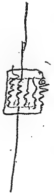



1/16

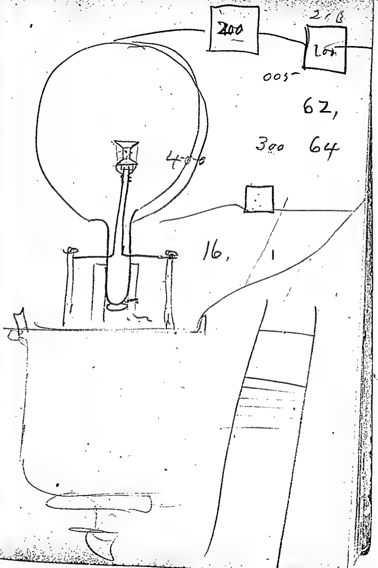

insulated
binding post
17 wire
binding post




30,
21.5
26.
18,



25

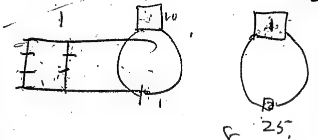


200
100
005
62,
300 64
400
16,
1

4 . 1 ohm.

5.

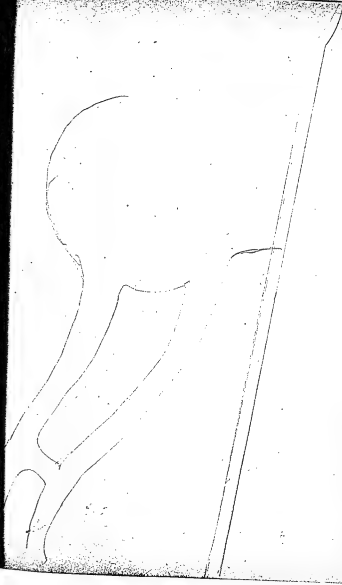
4 in light 1 in Mach

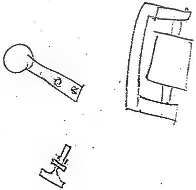


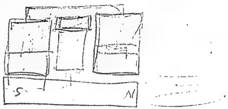
8 .2

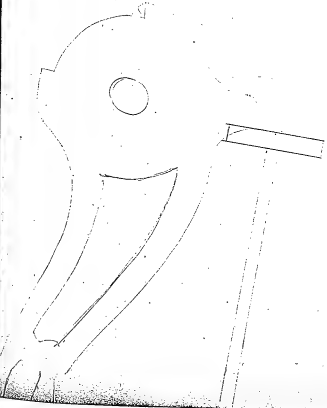
100.

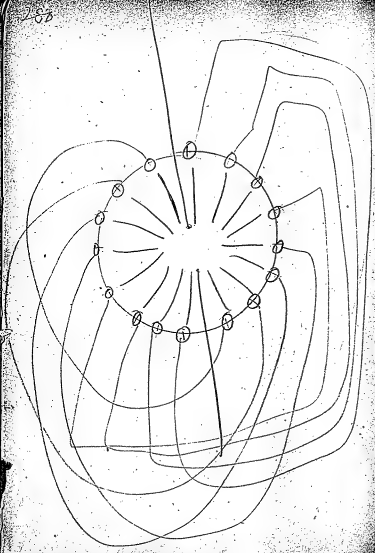
2 12. 8.

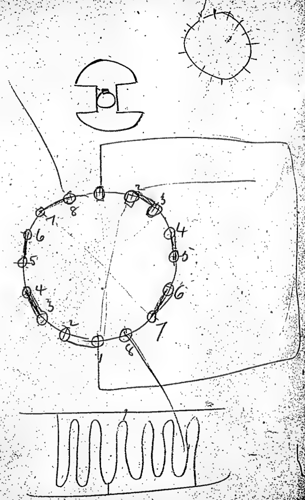


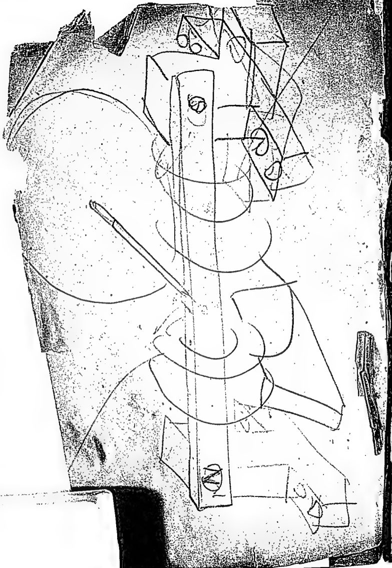



S
N






8
2
3
7
4
6
5
5
4
6
3
2
7
1
8



61
6
366 1.83 91 1:82 6
20 .. 125

Menlo Park Notebook #5 [N-78-12-02]

This notebook covers the period December 1878-January 1879. It contains experiments by Edison's nephew, Charles P. Edison, on the electromotograph telephone. The label on the front cover is marked "New Receiver." The book contains 285 numbered pages.

Blank pages not filmed: 6-7, 10-11, 20-21, 24-25, 28-29, 32-33, 36-37, 42-43, 232-233, 250-275, 280-281.

157
154
155
159
171

This note book contains Telephone Experiments and Chemical Tests for telephone experiments, for electromotograph telephone receiver of loud speaking telephone, made in 1878 & 1879, notes made by Charles P. Edison, brother of Thomas A. Edison.

(W. J. H.)

New Receiver — Dec 2nd 1876
Thos. A. Edison

Experiments with differant mixtures to ~~[illegible]~~ find out differand or change in resistance of Button when Soft in Crock with water

Pleonast Salts

Caustic Potash	NaCl
Carbonate of Potassium	$NaSO_4$
Sulphide of "	Na_2SO_4
Caustic Soda	
Ammonium Nitrate (saturated)	
Lithium chloride	
Strontium Chloride (sat.)	
Calcium Chloride	
Aluminium Chloride	
Aluminium + Sodium Chloride	
Beryllium Nitrate	
Magnesium Chloride	
Zinc Chloride	
Copper Nitrate	
Protochloride of Iron	
Chloride of Manganese	
" " Bismuth	

[illegible]

	when put in blood at	in 24 hours	diff
Pyrogallic + Nitrate Ammonia			
—			
Pyrogallic + Nitrate Calcium			
—			
Pyrogallic + Carb Potash			
—			
Pyrogallic + Chloride Zinc			
—			
Pyrogallic + Chloride Ca			
—			
Sugar —			
—			
7 - Pyrogallic + Sulphate Soda			
8 - Pyrogallic + Nitrate Strontia			
9 - Fluoride Calcium. Nit Ammon			
10 - " Nitrate Strontia			
11 - " Sulphate Soda			
" Carbonate Potash			

New Received
Dec 3rd 1878
Chas P. Emery

	When put in stood at	in 24 hrs stood at	difference
3 Fluoride Calcium + Nit. Calcium			
4 " " + Chloride Zinc			
5 " " + Chloride Calcium			
6 Gallic Acid + " "			
17 " Sulphate Soda			
18 " Nitrate Calcium			
19 " Nitrate Strontia			
20 " Carbonate Potash			
21 " Nitrate Ammonia			
22 Powd. Marble + " Strontia			
23 " Sulphate Soda			
24 " Carb. Potash			

5 Powd Marble + Nit Ammonia

6 " + Nitrate Calcium

7 " + Chloride Zinc.

8 " + Chloride Calcium

9 Bicarb Soda + nit Calcium

10 " + Chloride "

…ew Receiver Dec 5th 1878

Chas. P. Edison

Damar -	Nitrate Calcium	no 1	n.c. 5000	n.c. / n.c.	
. Damar -	"	" No 2	n.c. 1440	1400 / 2000	
"	+ chloride Calcium	no 1	n.c. 10100	n.c.	
"	" "	" No 2	1600	2400	1000
5 "	Chloride Zinc	no 1	130	Busted	
6 "	(Busted) "	no 2	140	Bu…	
7 "	Carb Potash	no 1	n.c.	…usted	
8 "	" "	no 2	n.c. 200		
9 "	Nitrate Ammonia	no 1	n.c.	Bu…	
10 "	"	no 2	n.c. 320	400 / 700 / 700	

New Receiver
Dec 3rd 1878
Chas P. Edison

New Receiver - Dec 5th 1878
Chas P. Edison

1	Daman	- Nitrate Strontia	1	n.c.	nc	n.c. nc
2	"	"	2	n.c.	n.c.	nc
3	"	Sulphate Soda	1	n.c.	nc	
4	Carb Baryta	- Nit Strontia	1	n.c.		
5	"	"	2	n.c.		
6	"	Sulphate Soda	1	n.c.		
7	"	"	2	n.c.	500	800 3000
8	"	Nitrate Ammonia	1	n.c.		
9	"	"	2	n.c.		
10	"	Carb-Potash	1	nc		
11	"	"	2	nc		

New Receiver Dec 5th 1878

Chas. P. Edison

1	Carb. Baryta – Chloride Calcium	1	NC	500	800 3000
2	" " " "	2	NC	1000	
4	" " Chloride Zinc	1	NC	2000	
4	" " "	1	NC	2000	
5	" Nitrate Calcium	1		2000	1900 NC 3000
6	" "	2	NC	500	1900
7	Bi Carb Soda "	1	NC	NC	
8	" " "	2	NC	NC	
9	" " Chloride Calcium	1	NC	NC	
10	" " "	2	NC		
11	" " Carb Soda	1	NC	NC	
12	" " "	2	NC	NC	1300

New Receiver - Dec 5th 1878
Chas P. Edison

3	Bi Carb Soda + Nitrate Ammon	1	NC		
4	" " " "	2	NC	100	
5	" " Sulphate Soda	1	N.C.	NC	NC
6	" " " (Busted)	2	NC	NC	
7	" " Nitrate Strontia	1	NC	NC	
8	" " "	2	NC		
9	" " Chloride Zinc	1	[illegible]		
0	" " "	2	N.C.		
1	Camphor + Nitrate Strontia	1.	NC	NC	NC
2	" " "	2	NC	NC	NC
3	" Nitrate Ammonia	1	NC	1100	NC
4	" "	2	N.C.	160	240

ew Receiver Dec 5th 1878
Chas P. Edison

1 Camphor + Carb Potash no 1	NC		
" " " 2	NC		
7 B. Carb Soda + Nitrate Calcium	NC	Burnt 160	
8 - Gallic Acid + Sulphate Soda	NC		
79 Flouride Calcium Sulphate Soda	NC	4 cost	too soft
80 - Gallic Acid + Nitrate Ammonia	NC	Burnt	
81 powd marble + Nitrate Strontia	NC	460	too soft
82 Flouride Calcium - Nit ammonia	NC		
83 Powd marble - Sulphate Soda	NC	NC	
84 powd marble + Nitrate Calcium	NC		
85 pyrogallic ov " "	NC		
86 gallic acid + Nitrate Strontia	NC	43	soft Burnt

New Receiver Dec 5th 1878
Chas P. Edison

- BiCarb Soda - Chloride Calcium	NC	30	Soft
powd marble + Nitrate Ammonia	NC	26	Soft
" " Chloride Calcium	NC	80	Soft
- pyrogallic acid + Nitrate Strontia	NC	100	soft

New Receiver Dec 6th 1878
Chas P. Edison

Sugar - Nitrate Strontia -	1	NC	2000	NC
" Nitrate Ammonia	1	NC	1000	soft
" "	2	NC		
" Carb. Soda	1	NC		
" " "	2	NC		
" Chloride Zinc	1	NC		
" "	2	NC		
" Chloride Calcium	1	NC		

New Receiver Dec 6th 1878
Chas P Edison

ulphate Magnesia + Nitrate ~~Chl~~ Calcium	NC	200	
" " " + Chlorides "	3000	40	110 / 110
1 " " Sulphate Soda 1	NC	70	100
02 " " Chloride Zinc	400	32	200 / 100
03 " " BiCarb Soda	NC	120	200 / NC / 170
04 " " Nitrate Strontia	NC	87	[illegible]
05 " " Nitrate Ammonia	875		
06 Phosphate Lime Nitrate Strontia 1	NC	NC	NC
07 " " — " " 2	NC	NC	NC
08 " " Carb Potash 1	NC	NC	
109 " " " " 2	NC	44	
110 " " Nitrate Ammonia 1	NC	90	27 [illegible]
111 " " " " 2	3000		
112 " " Sulphate Soda 1	NC	600	120 good
113 " " " 2	NC	50	[illegible]

Received Dec 7th 1878
Chas Edison

14 Phos Lime & Nitrate Calcium	NC	600	
15 " " Chloride Zinc 1	39	20	Soft Burst
16 " " " " 2	28	20	Soft Burst
17 " " Chloride Calcium 1	NC	600	~~700~~
18 " " " " 2	24	20	Soft Burst
19 Bermuda Arrowroot " 1	NC	NC	NC
20 " " " 2	NC	800	1000
21 " " Nitrate Calcium 1	NC	NC	NC
22 " " Sulphate Soda 1	NC	NC	
23 " " " " 2	NC	1000	
24 " " Chloride Zinc 1	NC	400 off	
25 " " " " 2	NC		
26 " " Nitrate ammonia 1	NC		
27 " " " " 2	NC	400 off	

New Receiver Dec 7th 1878

Chas. P. Edison

128	Burmuda Arrowroot - Nit Strontia 1	NC	NC	NC
129	" " " " 2	NC	NC	NC
130	" Carb Potash 1	NC		
131	" " " 2	NC		
132	Snuff Nitrate Ammonia 1	1000	600	
133	" " " 2	300		
134.	" Nitrate Strontia - 1	Pu[illegible]		
135	" Carb Soda	too soft		
136	" Sulphate Soda	NC		
137	" " 2	NC	~~180~~ Soft Buzz	
138.	" Chloride Zinc 1	NC	60	Soft
139	" " " 2	80	400	[illegible]

New Receiver Dec 9th 1878
Chas. Edison

140- Snuff + Nitrate Calcium	400	150	soft
141 " + " " 2	60	Soft	
142 " " Chloride Calcium	nc	110	soft
143 " " " " 2	Busted		
144. Dextrine - " " 1	to Soft		
145 " " " 2	140	soft	
146 " Nitrate Calcium	nc		

Dec 10th 1878

147. Nitrate Ammonia	nc	Bust
149 Carbonate Soda	to soft	
150 Nitrate Strontia	110	Soft
151 - Dextrine Nitrate Strontia	nc	nc
152 " " " 2	nc	

New Receiver Dec 10th 1878

Chas. P. Edison

153 Dextrine + Sulphat Soda		NC	
154 " + Sulph Soda		NC	NC
155 " Chloride Zinc		NC	NC
156 " " "	2	[illegible]	
157 Carbonate Soda		140 [illegible]	
158 " " "	2	[illegible]	
159 " Nitrate Ammonia		NC	NC
160 " " "	2	NC	NC
161 Bk, ox, Mang + Carb Potash		[illegible]	
62 " " " " "	2	514 [illegible]	
63 " " " Nitrate Ammon	1	NC	Perf

New Received Dec 10th 1878

Nat. J. Edison

163	Bk Ox Mang - Chloride Calcium 2	200	galv Soft
164	" " " " " 2	lo	soft
165	" " Chloride Zinc	90	Soft
166	" " " " 2	lo	soft
167	" " Nitrate Strontia	NC	Rusted
168	" " " " 2	NC	Soft
169	" " Nitrate Calcium	NC	3000
170	" " " " 2		Soft
171	" " Sulphate Soda	NC	1400
172	" " " " 2	NC	

Chas. P. Edison

) Tried experiment with button made of Ferrid cyanide Pottassium one half, Chalk one half. And small amount of Caustic Soda -- did not work) could not hear it

---

Made saturated solution Caustic Soda such as in Rock. and made button of chalk with strong solution also one of Woodbridge Clay with same solution

---

New Receiver Dec 12 1878

Chas P. Edison

Button of woodbridge
Clay - Caustic Soda after being
in box 24 hours is Non Conductor

Button of Chalk and Caustic
under same conditions
measured 3000. ohms res—

[redacted]

Make button for Receiver of
Sulphate Magnesia and
Sulphate Soda

#

Button of Sulphate
Magnesia and Sulphate
Soda with about half
Chalk—

New Receiver Dec 12 1878

Chas P Edison

Button of sulphate magnesia and Sulphate Soda with small amount of chalk —

---

testing button Sulphate Soda Sulphate Magnesia with about half chalk is an nonconductor, put in box No 200 —

Testing button Sulphate Soda Sulphate Magnesia with little chalk - is non Conductor put in box for testing No 201

New Receiver Dec 12 1878

Chas. P. Edison

Phosphate Lime and Sulphate Soda Button receiver Size

—

—

Phosphate Lime with strong solution Caustic Soda

—

Chalk Button for Receiver with Solution Sulphate Soda

—

New Receiver Dec 18th 1878

Chas. T. Edison

Button Rec. Chalk, Sulphate Soda - Acetate Mercury

Woodbridge Clay, Sulphate ~~mercury~~, Soda, Acetate Mercury;

New Receiver Dec 13th 1878
Chas. T. Edison

Experiments with Mercury Salts for conductivity

Sulphuret Mercury (black) good Conductor
Hydrarg, Oxid, nigr - Non Conductor
Bi chromat Mercury, very slight -
Iodide Mercury. good conductor Some Times other times not at all test it again
—
Bromide Mercury Non Conductor
—
Cyanide Mercury - gives 4 degs with heavy pressure on No 1 coil
—
Cyanat Mercury Non Conductor
—

New Receiver Dec 13th 1878
Chas. P. Edison

Experiments Mercury Salts - "Continued"

phosphor oxydulat - Mercury - Non Cond

Bi Iodide Mercury - Non Conductor

Hypophosphate Mercury - Non Conductor

Protochloride Mercury - Non Conductor

~~Proto Nitrate Mercury~~ -

thin button sulphuret mercury
gives no motograph action

New Receiver Dec 13th 1878

Chas. T. Edison

the button of Carb baryta. Sulphate Soda & Acetate Mercury when heated and dry test 3000 ohms

the above is good

New Receiver Dec 14th 1876

Thos. A. Edison

Sulphate Magnesia and BiCarb Soda No Motograph Effect

Phosphate Lime & Sulphate Soda Very Good Motograph Effect

testing button No 200 ~~tw~~ put in Box last night tried this morning and had good Emg Effect—

New Receiver Dec 14th 1878

Na_2SO_4 Chas. Edison

202 – Sulphate Magnesia, Sulphate Soda and about ½ chalk

No 202 – 24 hours in Box non Conductor no Emg Effect

203 Sulphate Magnesia + Na_2SO_4 in Box 24 hours Non Conductor No Emg Effect

---

[20]4 $Ca.CO_3$ + Na_2SO_4 + Hg $\overline{a}$

24 hrs is 10,000 ohms fair Emg Effect

[2]05 Ca_2PO_4 + Na_2O

24 hours in Box 460 ohms Emg Effect good

206 Ca_2PO_4 + Na_2SO_4

about 15000 ohms No Emg Effect

New Receiver Dec 14th 1878

Chas P Edison

Na_2SO_4 – $CaCO_3$ Slight Conductor after being in box 24 hrs – no Eng Effect

208 – $MgSO_4$ + Na_2SO_4 – Slight Conductor after being in box 24 hrs – No Eng Effect –

209 Na_2SO_4 + Hg ā + Woodbridge Clay – Has Eng Effect before putting in box

Dec 15th 1878 CPE

No 209 after being in box 24 hrs is 1000 ohms res. – Note – when first put up to be ~~changed~~ it tested 5000 ohms and decreased steadily until it reached 1000 ohms Can feel Motograph Effect but faint –

New Receiver Dec 15th 1878

Chas. F. Edison

No 205 — (Ca, peroxid nas so4 is bang up for Eng Effect after being in box 24 hrs work good for Calc Callard —

Carb Baryta Acetate Mercury and Sulphate Soda has bang up Eng effect after being in box 24 hrs — No 2-15

New Receiver Dec 16th 1878

Chas P. Edison

202 ~~[illegible]~~ tested after being in box 36 ... is only a slight conductor.

203. Tested after being in box 36 ... is but slight [illegible] [illegible] ... the [illegible] electromotive [illegible] [illegible]

New Receiver Dec 16th 1878 - Chas. T. Edison

No 204 - after being in box 36 hrs but slight Condn - showing 4 degrees - small Eng Effect -

No 205 - stood on Saturday 14th [illegible] [illegible] put in box down stairs by [illegible] and stands at 920 ohms this morning

~~small Eng Effect~~

Eng Effect good [illegible] [illegible] is as good as [illegible]

New Receiver - Dec 16th 1878 Thos A. Edison

No 206 - 36 hrs in box slight Condr-
Showing 3 degrs - Very small Eng
effect -

—

No 207 36 hrs in box slight Condr
Showing 2 degs - small Eng Effect

—

208 - 36 hrs in box slight Condr-
Showing only one degree -

—

209 36 hrs in box - [illegible]
on [illegible]
[illegible] no Eng effect

+

New Received Dec 16th 1878
Chas. P. Edison

Button of Precipitate Lime, Acetate Mercury, Sulphate Soda finely mixed, medium resistance and gives Bang up Emg Effect —

No 1212

Button Chloride Lime Acetate Mercury and Sulphate Soda is bang up for Emg Effect. Medium low ohms resistance

is the best button yet in

hand motograph

has been standing 6 hours in open air and works bang up one I held over light until it was hot and then worked just as well —

New Receiver Dec 16th 1878

Thos A. Edison

Button No 210 of Chloride Lime Acetate Mercury with a little chalk to stiffen is a little to soft wants more Chalk

---

Button 211 Chloride Lime and Phosphate Lime no Eng Effect — think it is to wet wants more Phosphate lime

New Receiver Dec 17th 1878
Chas. T. Edison

Button 212 which worked good last night after being left out all night has about 15000 ohms resistance this morning and very little Eng effect — after cleaning surface of button the Eng effect is much better — and when wet is as good a last night.

Button 210 under same conditions about same resistance and Eng Effect is N.G.

Button 211 same conditions measures 1400 ohms resistance and Eng Effect is N.G.

New Receiver Dec 17th 1878

Chas. P. Edison

Button 205 has stood out 48 hrs and conducts very little Emo Effect small —

Button 205 after being wet slightly works splendid with 2 cells [illegible] —

Sulphide Calcium - [illegible] Acetate mercury — [illegible] good conductor but [illegible] Emo Effect is poor gets better when wet

New Receiver Dec 17th 1876

Charles P Edison

Experiments to determine Conductivity of different Chemicals —

Experiments tried with 6 cells Callaud on no 1 coil —

Arseniate Manganese, Slightly —

—

Sulphate Silver — Slightly —

—

Lunar Caustic — Non Conductor

—

Sulphuret Silver ores — Non C

—

Red Sulphuret Antimony Non Cond —

Acetate Silver — Non Conductor

—

Carbonate Bismuth — Non Conductor

Chas P. Edison

Acetate Lead - Very slight Cond
Lactate Bismuth - Non Conductor

—

Bromide Silver Non Conductor

—

Bismuth Hydr Nitric - N.C -

—

Hydrarg, Oxydat, flav - Vruce - N C

—

Carbonate Silver - Very slightly -

—

Oxide Silver - - Very Small -

—

Cyanide Silver - Non Conductor

—

New Receiver Dec 17th 1878

Thos A. Edison

Sulphuret Tin - Good Conductor

Bismuth Valerianic - Non Condr

Antimon - Diaphoretic - N.C.

Protoxide Antimony - Slightly -

Mangan Hypophosph - non - Conducts a little. Shows [illegible]

Bisulphuret of Tin - Fair Cond shows Ladegonagai -

~~Tungstic Acid~~

New Receiver Dec 17th 1878

T A Edison

Tungstic Acid — when tested without weight is non Conductor with moderate pressure it increases Conduction until it is 700 ohms resistance and by taken pressure off ~~qu~~ is N.C. again

Stibium sulpurat Aurant — N C

Sulphuret antimony . N C

Stannum Sulfurat . N.C.

Carbonate of Lead — N.C

titanic acid — Slightly Cond

New Receiver Dec 17th 1878

Chas P. Edison

Protochloride Tin - Very good

Plumbum Chloride, cryst, N.C.

Chromate Lead - N.C.

Plumb Phosphorus, N.C.

Cadmium oxidat - very good

Tannate of Lead - N.C.

Iodide Lead - N.C.

Sulphate Lead N.C.

Mangan. Phosph... - N.C.

New Receiver Dec 17th 1878

Thos A Edison

Plumb. Carbonic — NON CONDUCTOR —

Hypophosph Iron — ditto

Phosphate Iron — ditto

Chromic acid 140 ohms no pressure

Borate of Copper Non conductor

Sulphuret Copper — Re [illegible]

Acetate Nickel — Non Conductor

Carbonate Manganese — Non Cond

New Receiver Dec 17th 1878
Chas. T. Edison

Bichromate Lead - NON CONDUCTOR -

Acetate Copper . cryst - Non Conductor

Subsulph Iron - Non Conductor

Titanic Acid - Non Conductor

Valer Iron - Non Conductor

Succinate Iron - Non Conductor

Carmine - Non Conductor

Sesquichloride Chrome - 140 ohms resistance without ~~[illegible]~~ pressure and no resistance with pressure

New Jersey Dec 18th 1878

Chas. P. Edison

Cuprum Oxydulat- Non Conductor
Cuprum Arsenicic - " "
Chromate Copper - " "
Cuprum oxydat " "
Chlorat Cuprum _ 9000 ohms resistance
Iodide Copper No resistance

Cupri Cyan: Non Conductor
Cuprum Oxalic ditto
Formate Copper ditto
Sulphate Cobalt Non Con
Nitroprussia Kupper _ Non Con
Natrum Formicicum _ Non Conductor

New Receiver Dec 18th 1878

Chas. P. Edison

Mangan Boracic - NON CONDUCTOR

Protoxide Nicol - ditto

Ferr. Tannic - Non Conductor

Tartrate Iron - Very Slight (cant measure it)

Cobalt Carbonic Very Slight

Nicol Carbonic - without pressure shows about 16.000 ohms with pressure. decreases to 4000 ohms

Nicol oxidic - Non Conductor

Alumina (pure) Non Conductor

New Receiver Dec 18th 1878

Thos. A. Edison

Iron Arseniate - Non Conductor
Ferrum Acetic Sicc - ditto

—

Protoxide Iron - ~~ete~~ Very slight Conductor without pressure (could not measure it showed only 2 deg) but with pressure resistance was reduced to 3000 ohms

—

Uran Nitric 1100 ohms resistance

—

Uran Kalium Acetic Non Con

—

Lactate Iron Non Conductor

—

Iron by Hydrogen see next page

New Receiver Dec 18th 1878
Chas. T. Edison

Iron by Hydrogen - without any pressure shows 2 degs Equal to about 15000 ohms. and with pressure there is no resistance whatever - by taking pressure off goes to 15000 ohms again. Can show any resistance by pressure -

Iodide Iron - Non Cond

Urani Sulfa - 200 ohms res
this one is wet

Urani Nitric - Non Conductor

Ferri Ammon Citras - Very Slight -

Charles P. Edison

Iron Oxalate - Non Conductor

Pyrophosphate Iron - Non Cond

Cerium Sulfuric without pressure 4000 ohms - with pressure 600 ohms.

Baryium Hyposulfuric - Non Cond

Iodide Baryum - 4000 ohms - moist -

Valerianate Magnesia - Non Conductor

Lactate Zinc - Non Conductor

New Receiver Dec 18th 1878
Chas P Edison

Phosphate Lime non Conductor

Aluminia Acetate. — N.C.

Sulphate Strontia N.C.

Oxalate Strontia — N C

Carbon of Lime - N C

Acetate Lime Very, Very, Small

Phosphate Aluminia N.C.

Oxalic Cobalt non Conductor

New Receiver Dec 18th 1874

Chas P Edison

Carbonate Zinc Non Conductor

Acetate Zinc Non Conductor

Alumin Sulfuric Non Conductor

Sulphate Lime Non Cond

Tartaric Magnesia non Cond

Magnesia Sulfite non Cond

Calcium Phosphate slightly +

New Receiver Dec 18th 1878

Thos A Edison

Chromate Strontia - without pressure 12000 ohms with pressure 4,400 ohms

—

Acetate Strontia Non Conductor

—

Carbonate Strontia Non Conductor

—

Baryum fluorat very slight

—

Strontium hydric Non Conductor

—

Sulphuret Barium without pressure about 2000 ohms with pressure 4.400 ohms

New Receiver Dec 18th 1878
Chas. P. Edison

Baryum Chloricum N C

—

Carbonate Baryta N C

—

Acetate Baryta N C

—

Phosphate Magnesia N.C

—

Corydalin N C

—

Fluoride Calcium N.C.

—

Hyperoxide Baryta N.C

New Receiver Dec 18th 1878
Chas P Edison

Zinci Cyanur - Non Conductor

Chinate Lime non conductor

Sulphate of Lime non Cond

Quinidine Sulphate - Non Conductor

Picrotoxin NC

Amygdaline NC

Bismuth Lactophosphate NC

Bromide Cadmium NC

New Receiver Dec 18th 1878
Chas P Edison

Valerianate Zinc - Non Conductor

Tartrate Potash 2600 ohms - dry

Natrium bi carbonic. non Cond

Sulphate Potash. non Condr

Nitrate Mercury 6000 ohms

Citrate Potash shows 6 degs

Molybdate Soda Non Cond...

Stannate Soda Non Condr

Carbonate Cadmium Non Condr

New Receiver Dec 18th 1878
Chas. F. Edison

Chromate of Potash – 2 degs.

Citrate Soda non Cond

Soda Fluoridum – Non Cond

Oxalate Soda Non Conductor

Tungstate Soda N. C.

Ferrocyanide Soda, very slight

Phosphate Soda Non Cond

Sulpho-Carbol Soda – Non Con

Chlorate Soda shows 6 degs
with pressure

New Receiver Dec 18th 1878
Chas. P. Edison

Hyperoxide of Lead - perfect Cond.
Tannate of Zinc - Non Cond.
Cobalt Oxydat - see next page
Cadmium Sulfurat N.C. -
Natrium pyrophosph N.C.
Bromide Sodium N.C.
Oxalate Cerium N.C.
Bisulphate Potassa N.C.
Sodium Sulforinate N.C.
Cadmium Sulfate N.C.

New Receiver Dec 18th 1878
Chas B Edison

Cobalt Oxydat - without pressure shows 1 deg on gal, 240 ohms with pressure

---

Chloride Zinc - N.C.

Sulphate Zinc N.C.

Sulpho Carbonate Lime, N.C

Bromide Cadmium N.C.

Sodium permangan gives 4 deg without pressure — 1700 ohms with pressure

New Receiver Dec 18th 1878
Chas. P. Edison

~~Zinc ferro~~
Zinc ferro cyanat - without pressure gives 5 dep - with pressure 4400 ohms

Lithium Carbonic - N.C.

Natrium Benzoic Non Conductor

Bi-sulphate Soda without pressure 1300 - with pressure 410 ohms

Cadmium Chloride 170 ohms without pressure - damp

New Receiver Dec 18th 1878

Chas. P. Edison

Nati Sulpho Carbonic - slightly shows 5 deg.

#

Manganate Soda - Slightly - Very Little

#

Crocus Antimony No Conduction

Iodimno nitro prusside - Non C

Nitrate Soda - Non Conductor

Hyposulphite Soda Non Condr

Hypophosphite Amon 400 ohms damp

New Receiver Dec 18th 1878
Chas P Edison

Patassium - N.C.

Kalium Bi-Carbonic N.C.

Iodide Sodium 100 ohms
<u>Note</u> turns it red by current <u>damp</u>

Binoxalate Patash slightly
showed 2 degs

Oxalate Patash - Non Conductor

Antimoniate Patash 740 ohms
slightly damp

Bisulphate Patash N.C.

Sulpho-Carbonate Pattasii NC

New Receiver Dec 18th 1878 137
Chas. P. Edison

Valerian Ammonia N.C.

Nitrate Potash. slightly. 3 degs

Ammoniac Sulphite N.C.

Chloride Potassia N.C.

Ammon Uric Non Conductive

Anthracate of Potash 740 ohms
Wet

Tartrate of ammonia . N.C.

New Receiver Dec 18th 1878
Chas. P. Edison

Kalium Carbonic 470 - no dery moist

Chromate Patassa 6000 ohms

Sulphate Amonia slightly 7 days

Kalium Hypermangan N.C.

Tungstate Ammon N.C.

Succinate Ammonia N.C.

Ammon Uric N.C.

Cyanide Patassium

New Receiver Dec 18th 1878

Chas P Edison

Phosphate Potash N.C.
Chlorate Potash. N.C

Antimoniate Potash. 800 ohms

Kali Hyperchloric N.C.

Phosphate Ammonia. N.C

Caustic Baryta : N.C

Chrom oxydat N.C.

Cinnabar — N.C

Brucin — N.C

New Receiver - Dec 18th 1878
Chas. P. Edison

Asparagin - Non Conductor

Brown Aniline Non Conductor

Caffein Valerianic Non Cond

Beryll - oxydat Non Conductor

Caffein sulphuric Non Cond

Asarone Non Conductor

Yellow Aniline Non Con

Ammon Boracic Non Con

New Receiver Dec 18th 1878
Chas P Edison

Ammon Citric non Cond

Ammon carbazotic non Condr

Opocymin non Cond

Ammon Bi Carbon non Condr

Hydrobromate Ammonia N.C.

Ammon Gallic non Condr

Antimon Hepar non Condr

Bebeerin Muriate non Condr

Gum Renzoe non Condr

New Receiver Dec 18th 1878

Chas P Edison

Aniline Green Non Cond.

Red Aniline. Non Cond

Berberin Sulph. Non Con

Berberin (Pure) Non Con

Molybdate Ammonia - N.C.

Hydro Jodate Ammonia N.C.

Blue Aniline. Non Cond

[illegible] nut [illegible] Non Cond

[illegible]osmin Non Cond

Citrate of Caffein Non Cond

Alloxane Non Cond

New Receiver - Dec 18th 1878
Chas. P. Edison.

Iodide Ammonium - Very slight
Benzoate Ammonia Non Con
Caryophylli Non Cond
Caffein non Conductor
Baptisin Non Conductor
Alloxanton - Non Cond
Cascain Non Cond
Lycopodium Seed N.C.
Bimalic Ammonia N.C.
Aloin N.C.
Cerium Oxydat N.C.

New Receiver Dec 18th 1878
Chas P Edison

Turmeric Non Conductor
Cantharides Vaica Non Cond
Napthaline N.C.
Mannite N.C.
Palmetinic Acid N.C.
Piperine N.C.
Molybdaenic Acid without pressure shows 5 degs with pressure 800 ohms
Narcotine Non Conductor
Menispermin Non C.
Chlor. Propylamin NC
Cinchonidia NC
Quinidine NC

New Receiver Dec 18th 1878
Chas P Edison

Lupulin Non Conductor
Cinchonidin sulph N.C.
cinchonin N.C.
Chinin Valerianic N.C.
Morphine N.C.
Chinic Acid N.C.
Quinine Acetate slightly ? [illegible]
Quinine Arseniate Non Condr
Cochineal No good
Quinine Tannate Non Condr
Quinine Bromide Non Condr
~~Malic Acid~~
Jalapin Pur. Alb. N.C.
Morphiae Murias N.C.
Glycochol N.C.

New Receive Dec 18th, 1878 (151)

Chas P. Edison

Strychniae Nitras NC

Morphine Valerianate NC

Morphiae Bi Mecon NC

Quinine Citrate NC

Quinine Ferrocyanide NC

Cinnamylic Acid NC

Quinine Iodide NC

" Hypophosph NC

Elaterium NC

Hippuric Acid NC

Glucina carb NC

Cubebin

Digitalinum Pur NC

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New Receiver Dec 18th 1878
Chas P Edison

glycyrohizine NC.

Quinine Lactate NC

Santitine NC

Theine NC

Acet Strychnia NC

Sulph Strychnia NC

Iodide Strychnia NC.

Quinine muriate NC

Uric Acid NC

Thymol NC

Ultramarine NC

New Receiver Dec 18th 1878
Chas P Edison

Uric acid NC

Veratrine NC

Urea Pura NC

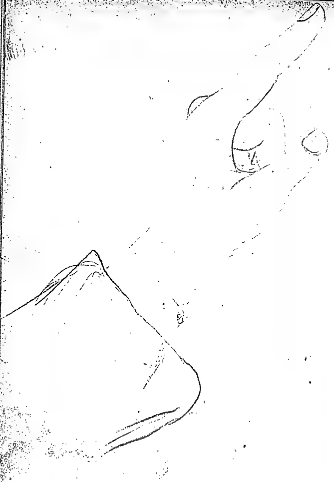
Strychnia NC

Saponin NC

Santonine NC

Pepsine NC

Proteine NC



New Receiver Dec 19th 1878

Chas. P. Edison

Foliated Tellurium 70 ohms resistan

Carbazotic ~~acid~~ Non Conducto

Camphoric Acid - N.C.

Carbon trichlor. crist.

Phosphor Amorph. soft

trichlor Carbon cryst. N C

~~Tellur~~

Selenium Non Condr

New Receiver Dec 19th 1878 (63)
Chas P Edison

Iodic Acid _ 70 ohms X dry

Iodide Sulphur Non Cond

—

Gum Myrrh Non Cond

—

Phosphate Lime . Non C

—

Grape Sugar N.C.

—

Gum Kino N.C.

—

Sulphate Soda 300 ohms

—

Litharge _ non Cond

—

Brazil Wood N.C.

New Receiver Dec 19th 1878
Chas P Edison

Gum Benzoin N.C.

Gum Dammarah N.C.

Oil Mace - pressed N.C

Gum Tragacanth N.C.

Gum Olibanum N.C

Tannin Non C

Gum Zanzibar non C

Gum Arabic non C

Madder non C

New Receiver Dec 19th 1878 167

Chas P Edison

Paris Green — Non Conductor

~~Scotch Snuff~~ N. C.

Iceland Moss N C

Gum Damar N C

Arsenic Acid N C.

Milk sugar N C

Gum Guiacum N C

Bi Carb Soda N C.

New Receiver Dec 19th 1878 159

Chas P Edison

Grape Sugar Non Conductor

Dextrine Non Conductor

Cocoa Butter Non Conductor

Asbestos non Conductor

Gum Ammoniac Non Condr

Chlor Potass Non Conductor

Bermuda Arrowroot Non Cond

Camphor non Conductor

New Receiver Dec 19th 1878
Chas. P. Edison

Salt Peter Nonconductor

Animal Charcoal shows 5 degs

Gold ore non conductor

Asphaltum Non Conductor

Borax – Non Conductor

Alum – Non Conductor

Sal Ammoniac non Conductor

Rotten Stone – non Conductor

New Receiver Dec 19th 1878 173
Chas. P. Edison

Ore, brize Lode - good conductor

Ore, Pewafic Lode, good Conductor

Parafine — non Conductor

Spermacetti — Non Conductor

Chloride Lime went up to 7 degs and polarized

Fire clay Non Conductor

Per ox mang - 70 ohms

Indian Hemp non Conductor

Sugar - shows .2 degs

New Receiver Dec 19th 1878
Chas P Edison

Sulphate Zinc _ non Conductor

—

Ferrocyanide Pattasium N.C.

—

Bronze Non Conductor

—

Sumac Non Conductor

—

Russian Isinglass N.C.

—

Chalk _ non Conductor

—

Protosulphate Iron Non Con

—

Rosin _ non Conductor

New Receiver Dec 19th 1878.

Chas. P. Edison

Sago — Non Conductor

Gamboge — non Conductor

Bichromate Potash N.C.

Gum Hemlock N.C.

Dog wood — N.C.

Ferro Cyan Potash N C

Argols Non Cond

New Receiver Dec 19th 1878
Chas. P. Edison

Tripoli - non Conductor

Zinc. grain good Conduc

Cam wood non Condu

Flax non Conductor

Saffron non Condu

Sesquichloride Iron $\frac{54 \text{ ohms}}{\text{damp}}$

Palue Flag show 1 deg with pressure

New Receiver Dec 19th 1878
Chas P Edison

Catchen Nonconductor

Potassii Chloridum N.C.

Rutile Titanium Oxide N.C.

Logwood non Cond'r

Sulphuret Iron, perfect Cond'r

Quince Seed N.C.
White Snake root N.C.
Cinnamon Bark N.C

New Receiver Dec 19th 1878
Chas. P. Edson

white Bryony root	n c
Rosemary Leaves	n c
" Flowers	n c
Blood root	n c
Gum Myrrh	n c
Hounds Toungue	n c
Colts foot root	n c
Cardamon Seeds	n c
Orris root	n c
Zodary	n c
Pomegranate Peel	n c
geranium	n c
Button snake	n c
Plantain seed	n c

New Receiver Dec 19th 1878

Chas P Edison

wild Cherries	n c
Ipecac	n c
Pareva Brava	n c
Pumkin Seeds	n c
Peach Pits	n c
Anise Seed	n c
Savin.	n c
Muskmelon seed	n c
Borage Flowers	n c
German Valerian	n c
Mountain Heath	n c
Burdock Seed	n c
Buckthorn Berries	n c
Carroway Seed	n c
Indian turnip	n c

New Receiver Dec 19th 1878

Chas. P. Edison

golden seal nc

sweet birch bark nc

Black Mustard seed nc

Scurvy grass nc

Wild Hound tongue nc

Squaw week nc

Yellow Pond Lilly root nc

white ash Bark nc

Mountain ash Bark nc

Angelica tree Seed. nc

Manna nc

Chicory root nc

Cascarilla Bark nc

Tormentilla nc

Colts foot root nc

Angustura Bark

New Receiver Dec 19th 1878

Chas. P. Edison

Wood Betony	NC
Pin Oak acorns	NC
yellow Jasamine root	NC
Simarubia bark	NC
gold thread	NC
Quecins Alba	NC
Unicorn Root	NC
Comfrey root	NC
Eucolyptus	NC
Poppy Caps	NC
Fumitory	NC
Belladona root	NC
Pussy willow bark	NC
Chiretta Herb	NC
Lemon balm	NC
Peony root	NC

New Received Decl 9th 1878

Chas P Edison

Beni Violet #	N C
Asplenium Felix	N C
Buck Bean root	N C
Hibiscus	N C
Alum root	N C
Wild Celadine	N C
Wild Carrot Herb	N C
Aconite Root	N C
Liverwoot	N. C.
Sassafras Pith	N C
Fenugreek Seed	N. C.
Yellow root	N C
Apple tree bark	N C
Dewberry root	N C
Dogwood	N C

New Receiver Dec 19th 1878

Chas P Edison

Bitter Orange peel NC
Ginger root NC
Potentilas repens NC
Ergot NC
Mexican Sarsparilla NC
Blackberry root NC
Bitter almonds NC.
[illegible] NC
Soap bark NC
Rose flowers (leaves) NC
Colombo NC
Lung Moss NC
Ginseng N.C.
Barbary Bark NC

New Receiver Dec 19th, 1878
Chas R Edison

Blue Cohosh NC
American Colombo NC
Low Centaury . . NC
Wafer ash Bark NC
+ Chloride Baryium N.C.
Ammonia Citrate Iron shows
5 dips – with pressure
Fusible Metal good conductor
Pebble stones – Non Condr
Fused Nitre " "
Stearic Acid " "
Arsenious Acid " "
Sesqui-oxide Iron " "

New Receiver Dec 19th 1878
Chas P. Edison

Phosphate Soda - non Conductor

Iron ~~with~~ with Sulphur - good conductor

Bi-Tartrate Potash - non Cond

woodbridge Clay "

Iron Pyrites "

Sulphate Calcium "

Soap stone "

Benzoic Acid "

Silicic acid "

Gum Senegal "

Black Flux 8000 ohms res -

Ferro Cyan Iron Non Conductor

Oxide Copper shows 3 degs

Acetate Soda " 2 "

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New Receiver Dec 19th 1878.
Chas. P. Edison

Iodide Lead Non Conductor

Aniline red shows 2 degs

Hickory Nut shell - Non Condr

Tar - Non Conductor

Carb. Copper - Non Condr

paper soaked in Sat Sol Nit Potash - Non Conductor

Boric Acid - Non Condr

Litmus Non conductor

Burnt umber Non Condr

Oxalate Ammonia N C

Arsenious Acid N C

New Receiver Dec 19th 1878
Chas. P. Edison

Carbonate Iron N. C.
Anthracine N. C.
Sulphate Mercury 440 ohms damp
Brass Filings. Conductor by Heaviy
Oxalate Iron Non Conductor
Bonia's phosphorus. Non Condr
Wach's phosphorus, Non Condr
Powd. Battery Carbon - perfect Condr
~~Carb Ammonia ...~~
Horse Chesnuts - Non Condr
Pumice Stone Non Conductor
Gum Substitute N C
Amalagam good Conductor
Sulphate antimony

New Receiver Dec 19th 1878
Chas P Edison

Antimonic acid nonConductor

Pepper - NonConductor
Amber - NonConductor
Spongy Platinum perfect Condr
Pulv. Aloes - N.C.
Borate Baryta N.C -
Prussian Blue N C
Ferro Cyan Copper N.C.
Galic acid N.C.
Brimstone N.C.
Sulphate Potash N.C
Sulphide Calcium N.C.
Carb Potash - 140. ohms (wet)

Sand Plain

two men of Sandy Bar

New Receiver Dec 9th 1878 205
Chas P Edison

Powd Charcoal Non Conductor

Pyrolusite 40 ohms ores

Tartaric Acid Non Conductor

Purging Cassia non Conductor

Carbon made from gas perfect Conductor with pressure

Sumack Leaves non Conductor

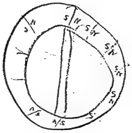
Acetate Mercury N.C.

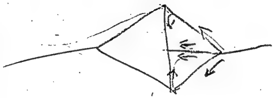
Fluoride of Calcium N.C,

Arsenious Acid N.C.

New Receiver Dec 19th 1878

Thos A Edison





New Receiver Dec 22nd 1878

Chas. T. Edison

Chewing Tobacco - 3700 ohms res

Cyanide Potash 9000 ohms

Sudbear - Non Conductor

Bromide Potass non Conductor

Nitrate Ammonia shows 3 degs

Flower Sulphur - Non Conductor

Butter Nut Bark - Non Conductor

Chloral Hydrate - shows 2 degs

Tumeric - Non Conductor

Chlorate Potash - Non Conductor

New Receiver Dec 22nd 1878

Chas P Edison

Cadys Lampblack - perfect Conductor

Methylviolet - Non Conductor

Permanganate Potash - 2000 ohms

Powd Charcoal - shows 1 deg

Baric Chloride Non Condr

garden Celamine Non Condr

Nut galls non Conductor

Powd Marble N.C.

Walnut shell N.C.

Oxalic acid show 3 degs

New Receiver Dec 22nd 1878
Chas. P. Edison

Rosin Weed Non Conductor

Pennyroyal N.C.

Male Fern Root N.C.

Dragons Blood N.C.

Buckeye N.C.

Sumac N.C.

Shoe Makers Wax - Cant get d— stuff out of bottle

Tellurium Ore - N.C.

Sulphuret Soda - N.C. -

New Receiver Dec 22nd 1878 215

Chas. P. Edison

Carb Magnesia N.C.

Iodine Resublimed N.C.

Nitrate Strontia N.C.

Drop Black ~~1000~~ 100 ohms

Red silk cut 1/2 doz times over with plumbago - good -

Lamp Black made from gasoline Combustion furnace - perfect Condr

Scarlet Aniline - Non Conductor

Black Aniline (water)

Goldbeaters Skin

New Receiver Dec 22nd 1878

Chas P Edison

Black Aniline (Alcohal) N.C.

Jobs Tears N.C.

Elicompane seed N.C.

Silk boiled in Chloride Zinc 100 ohms

HAIR From a BAT with Carbon, Good Conductor

Balsam apple seed N.C.

Pulv Scamony. N.C.

New Receiver Dec 22nd 1878

Chas. P. Edison

Birds foot Violet - N.G.

Cape Aloes N.G.

Balsam Apple Fruit N.G.

Blk Hellebore Root. N.G.

New Receiver Dec 29th 1878
Chas. F. Edison

Experiments with paper soaked with differant oils. for conductivity with No 1 coil + 6 cells Callaud battery

—

Oil Cloves — nonconductor
" white thyme "
" Fennel "
" Croton "
" Fusel "
" Wintergreen "
" Spearmint "
" Anise "
" Juniper Wood "

New Receiver Dec 24th 1878

Chas P. Edison

Juniper Berries	non	Condr
pennyroyal	"	"
Orange	"	"
Bergamot	"	"
Lemon	"	"
Succini	"	"
wormseed	"	"
Citronella	"	"
Rosemary	"	"
Tansy	"	"
Carui	"	"
Cade	"	"
peppermint	"	"
Lemongrass	"	"
Lavender Flower	"	"

New Receiver Dec 26th 1878 —

— " — Chas Edison

~~Sulphuret Tin~~

The following Chemicals &c are good Conductors and good for base of button. —

— " —

Sulphuret Tin

—

[illegible]

Cadmium Oxyde

Chromic Acid [illegible]

Sulphuret Iron

Sesquichloride [illegible]

Chlorate [illegible]

Rec Receiver Dec 26th 1878

Chas P. Edison

Nickl Carbonic –

protoxide Iron

Uran Nitric

Uran Kalium Acetic

Iron by Hydrogen

Uran Sulfuricat –

Cerium Sulfuric

Iodide Barium

Chlorate Strontia

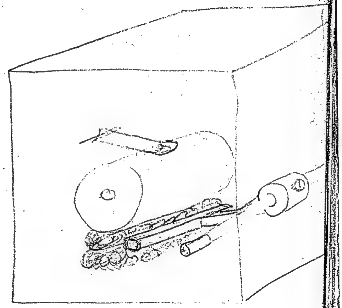
Tartrate Potash

Cobalt Oxydat

Sodium Permanganate

New Lamp Dec 6th 1878

Chas P. Edison



Now i is the winter of our discontent

Charles

New Year

Now is the

The win

now is the winter of our

Now

Now is the winter

Happy New Y

A happy New Year

Merry Christmas

Mid :

Midnight Midnight

Midn Mid Middle of the night

Midnight

Midnight

Dear Sir Received

Yours R

New Receiver 23

New Receiver

A

Happy New Year

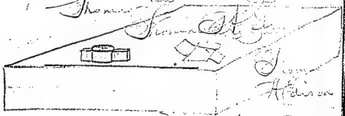
NEW RECEIVER

Dec 28th 1875

New

New Receiver

New



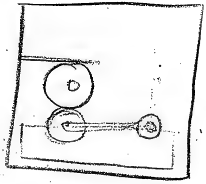
Addison

Dear

NEW RECEIVER Dec 2[illegible] 187[illegible]

204

Chas P E



205

New Receiver Jan 7th 1879

Chas. P. Edison

\#

Bases for Buttons using Caustic Soda and Acetate Mercury for each

\#

Black oxide Manganese has no Motograph Effect does not mould good and when wet is to soft

\#

Carbonate [illegible] has good E.M.G. Effect and moulds good

\#

Litharge has very little Emg Effect dont mould good –

New Receiver Jan 7th 1879
Chas. Edison

Tripoli - has fair emf effect

but the motion does not appear [illegible] seconds after the [illegible] has been [illegible]

damar — works [illegible] opposite to [illegible] more [illegible] when the [illegible] is on

Tripoli is to soft after being wet it all scales off

N.G. NO GOOD N.G.

New Receiver Jan 8th 1879

Chas. P. Edison

Button turned from Juice of Charcoal soaked in Solution Caustic Soda, dried out, and then soaked in Solution of acetate mercury is no good has no Motograph Effect whatever has [illegible] resistance

Chlor Potass has fair Emf Effect but does not mould good, crumbles,

Caustic Magnesia has good Emf Effect Moulds good

New Receiver. Jan 9th 1879. 241

Chas. P. Edison

Caustic Phosphorus has pretty good Eng Effect - but dont mould as good as chalk

---

Nut galls. has a Little Eng effect - but is n.g. by putting water on. Makes a paste on surface

---

Brimstone - has very slight Eng Effect - is too soft when water is put on

---

Sulphate Antimony has very small Eng effect. Moulds good

New Receiver Jan 9th 1879
Chas [illegible]

Burnt Umber has excell good Emg effect also [illegible] good

Sugar is Ng. for Emg Effect

Ferrous Chloride with Chalk and [illegible] Mercury has no Effect

Anthracine with Acetate [illegible] has no Emg Effect

New Receiver Jan 9th 1879
Chas P Edison

Borate Baryta has
good Emg Effect and
moulds good

Bromide Potassium has
Very small Emg [illegible]

Sulphide [illegible]
pretty good Emg
but is too [illegible]
crumbles

Ww Received Jan 9th 1879 247

Chas. P. Edison

[illegible] of [illegible] [illegible]
first [illegible] in solution
of Acetate [illegible] Mercury and
then [illegible]
Caustic Soda [illegible]
the [illegible] [illegible]
Motograph [illegible] is N.G.

Bi Carb Soda [illegible]
Eng. Effect [illegible]

Alum [illegible]
Eng. Effect [illegible]
good

New Receiver Jan 9th 1879
Chas. P. Edison

Whitning - has good Emf Effect as good as chalk if not better moulds good will make large one for Recr

Borax fair Emf Effect moulds - good

Alum has nothing Effect Chg.

B Barium Iodide

C Cadmium oxide 9d
Chromic acid wet 3/-
Copper sulphate 9d
Chrome, sesquichloride 140
Cyerium chloride 9oz.
Cerium Sulphate
Cobalt oxide

D

E

F

G

H

I Iron persulphate
" bichromate

J

K

L

M

N Nickel oxide

Y

3

P Potash chlorate

Q

R

S ~~Sulphuret Tin~~
Alumina Chlorate
Sodium Permanganate
Sulphate Silver

T Tin Sulphuret of
Protochloride Tin of

U Uran nitric
" Kalium [illegible]
" Sulfur wet

V

W

X

57 5 6 5

Sat _ 7

Sun 8

Mon 12

Tues 13

Wed 14

Metals 283

Na_2SO_4 _ Sulp Soda.

$CaCO_3$ Chalk

Hg-ā Ac mer

Ca_2PO_4 ~~Phosphate~~ Sulphate Lime

Na_2O Caustic Soda

$MgSO_4$ Sul Magnesia

137
138 Anthracene
142 Sulp Merc
145 Powd [illegible] Carbon
146 Pumice Stone
147
150 Sulph Antimony
151
153 Pepper
154
155 Borate Baryta
159 Prussian Blue
160
163 Brim Stone
165
165 Sulphate [illegible]
168 Sulphur [illegible]
16[illegible]
171 Charcoal

[illegible] Chemical
Aspirin [illegible]
Borax
Alum
Sal Ammoniac
Rotten Stone
Fire Clay
Bi Carb Soda
Chlor [illegible]
Bermuda [illegible]
Salt Petre
Bi Chrom Potash
Potassium [illegible]
Chemist [illegible]
Hyposulphite [illegible]
Sulphur
Tar
[illegible]

Menlo Park Notebook #6 [N-78-12-04.1]

This notebook covers the period December 1878-January 1879. Most of the entries are by Francis Upton. There are also entries by Edison, Charles Batchelor, and John Kruesi. All of the material relates to experiments on electric lighting. There are many calculations by Upton about generators and system costs, including comparisons to gas lighting costs; drawings and tests of lamps; notes on silicon and graphite; and notes and drawings of generators. The book contains 284 numbered pages.

Blank pages not filmed: 214-249, 254-257, 266-273, 280, 283.

Missing page numbers: 275-278, 281-282.

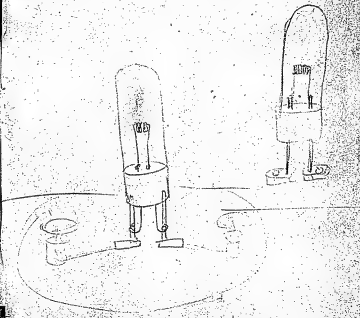
No 6

[illegible] N.Y.C.

May, 189..

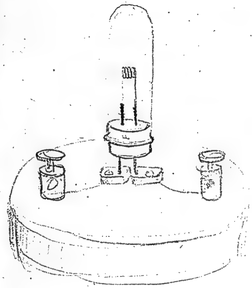
Electric Light Dec 17 10 1880

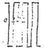
J Kruesi



Electric Light Dec 4 10 1878 3

J Kruesi

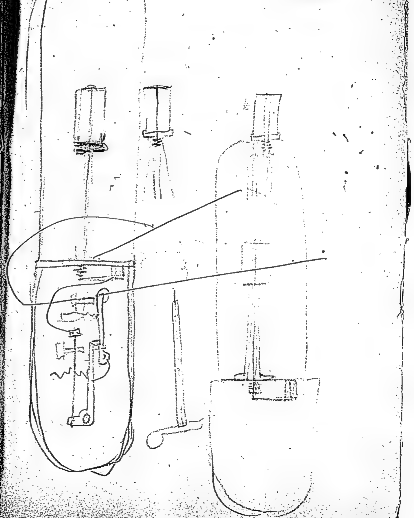




Electric Light

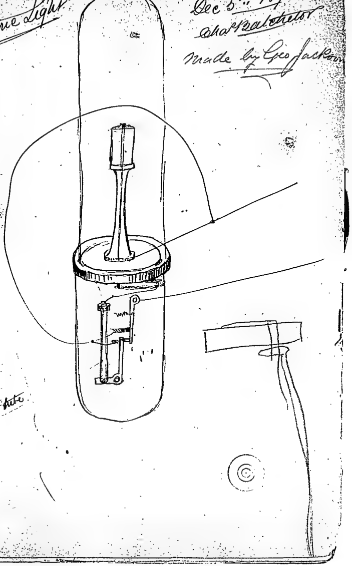
Dec 5th 1878

Chas Batchelor



Electric Light

Dec 5th 1878
Chas Batchelor
Made by Geo Jackson



$I = E\,\frac{1}{1}$ -

$\cancel{R} = \frac{\cancel{12}}{\cancel{3}}$

Heat $= C^2$

$C = 1$
$R = 1$
Heat $= 1$

$C = 2$
$R = 1$
Heat $= 4$

$C = \frac{E}{R}$

Heat $= C^2 R$

~~1 HP~~ $E = 1$
$R = 1$

$C = \frac{1}{1} = 1$

Heat or work $= 1$

~~2 HP~~ $E = 2$
$R = 1$

$C = \frac{2}{1} = 2$

Heat or work
or H.P. $= 2^2 \times 1 = 4$

12 Wallace
100 revolutions

R = 10 Ohms Outside
r = 10 inside
1 Horse power to rotate
machine independent of the
current
2 Horse power in
Electro motive force = 1
Outside work 6 lamps

Double the speed
H.P. No Lamps ?

~~24~~ inches Batch 13
19 inches Edison
$7\frac{1}{4}$ 22 " Mark

1 H.P. for Elec

$\cancel{E} C = \frac{20}{10+10} = \cancel{0}\ \frac{1}{2}$

2 H.P. in all Work = ~~1~~
~~$\frac{1}{2}$ Work [illegible]~~

2 H.P. for friction
4 Hp for Elec
6 H.P.

$\frac{2}{3}$ work per HP

6 Hp Work 4

$\frac{2}{3}$ $\frac{4}{3}$ $1\frac{1}{3}$

4 HP. for friction
16 HP " Elec

20 HP in all

$\frac{16}{20}$ $\frac{4}{5}$ work for H.P.

No 1 100 HP Work = $\frac{1}{2}$
2 200 revolutions " " = $\frac{2}{3}$
3 400 revolutions " " = $\frac{4}{5}$
4 800 revolutions " " = $\frac{8}{9}$

8 Hp
64

72

$\frac{64}{72}$ $\frac{8}{9}$

$\frac{3}{2}$

16 1000 revolutions
Friction 1 H.P.
Elec 1 H.P.

External $R = 10$
Internal $r = 10$

1 lamp outside for two Horse Power
10 inches with one unit of work on the ten inches

$$C = \frac{20}{10+10} = 1$$

$$\cancel{Heat} = C^2R = \cancel{1}0$$

$$Heat = C^2R = 20$$

2000 revolutions 17
Friction 2 H.P.
Elec ~~4 H.P.~~ ?

External 30
Internal 10

$$C = \frac{4\cancel{E}}{30+10} = \frac{40}{40} = 1$$

$$Heat = C^2R = 30$$

~~3 lamps for 5 H.P.~~

No. 1. $\frac{1}{2}$ lamp for 1 HP
$\frac{3}{5}$ lamps " " "

14 4 000 Revolutions

~~4 H.P. for Traction~~

7 H.P. for Elec.

10 inside

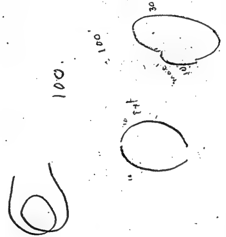
Right 5-0 150

Left 5-0

1/2 1 3

2 4

2 100

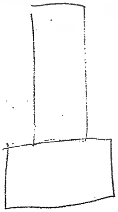


 1000 revolutions

2 Horse power put on a Gramme machine will give 1000 revolution the total resistance being 20 Ohms, 10 in & 10 out.

If the Horse Power is doubled i.e. 4. H. P and the total resistance is doubled i.e. 30 out 10 in = 40, the speed of the machine will increase to 3.000 revolutions and double

22



a Gramme machine

Gives 85° in work

23

the work will be obtained,

2 H. P.

Perfect Gramme

~~1~~ H. P 1000

10 inside 20=E
10 outside

C = 1 Total Work = 20
Useful " = 10
Useless " = 10

1 H P 2000

5 inside
~~15~~ outside

Total = 20.
~~15~~ Useful = 15
Useless = 5.

24

4000 revs

$2\frac{1}{2}$ inside

$17\frac{1}{2}$

17!

20 total

$17\frac{1}{2}$ useful

$2\frac{1}{2}$ useless

$1\frac{1}{4}$ 8000

$\frac{3}{4}$ 16000

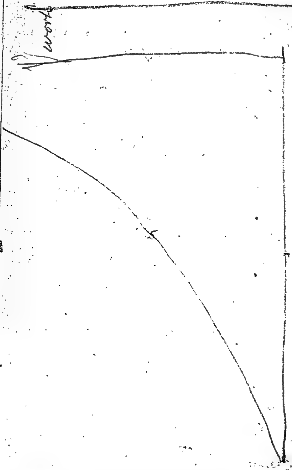
$\frac{3}{8}$ 32000

25

Perfect Gramme

If the speed is doubled the electromotive force is doubled. If the internal resistance is halfed the E-F is halfed, at the same time ~~and~~ external increased half; Total the same. If both at same time Elec. Force remains constant

Gramme 85 Elec
15 Friction



50 % friction Gramme
50 % Electricity

1 H.P. Friction
1 H.P. Electricity
1000 revo = 2 H.P

10 out = R
10 in = r
C = 1

Work = 20 Units
useful = 10
useless = 10
5 useful per H.P.

15 out
5 in
2000 revolu.

~~2~~ H. P friction
1 H. P Elec = 3 H. P

Work 20
useful 15
useless 15
5 useful per H. P.

72 Friction
28 Current ; Wallace

1. H. P Current
3 H. P Friction

1000 revs
10 in
10 out

20 work
10 useful
10 useless

Useful per done power $2\frac{1}{2}$ per H. P

2000 revolutions
5 in
15 out

20 work
15 useful
5 useless

6 Hp friction
1 H.P
7

$\frac{15}{7} = 2\frac{1}{7}$

° ° tog Gramme

45 Friction
55 Current

$\frac{1}{4}$ Current
$\frac{3}{4}$ Friction
$= 1$ HP
$1\frac{1}{x}$

4 HP

30 Siemens   15 Frictions
85 Current

$\frac{3}{13}$ HP Friction
1 Hp Current

~~[illegible]~~ revol.
10 in
10 out

work 20
useful 10
useless 10

10
$1\frac{3}{13}$

8.1 Useful per H.P.

~~[illegible]~~ ~~revolution~~
5 in
15 out

$\frac{6}{13}$ Friction   20 Work
1 Current   15 useful
5 useless

$1\frac{6}{13}$ total H.P.

10.2 Useful

31

~~2~~ $\frac{3}{13}$

13) 3.0 (23
26
40
39

1.92

1.23) 10.00 (8.1
9 84
160

1.92) 17.5

1.46) 15.0 (10.2
146
400

4X
$2\frac{1}{2}$ 2.5
$17\frac{1}{2}$ 17.5

4000 revolutions

$\frac{12}{13}$ Friction $17\frac{1}{2}$ useful
1 Current $2\frac{1}{2}$ useless

$1\frac{12}{13}$

32

33

$\frac{1}{2}$ Fire Cur[illegible] = 1

$\frac{1}{2}$ Current

4 ounce

1 Fraction 4

2 ~~3~~ Current 3

4 oz

3 Work 4

$\frac{1}{2}$ Work 1

~~2~~ $\frac{1}{2}$

$\frac{3}{4}$

34 2 cores

$\frac{1}{2}$ H.P. Friction

$\frac{1}{2}$ H.P. Current

---

4 cores

1 H.P. Friction

2 H.P. Curr

3

13) 100 (.8

April 1 38

4 Friction 1 H.P. $\frac{20}{10}$

Current 1 H.P.

---

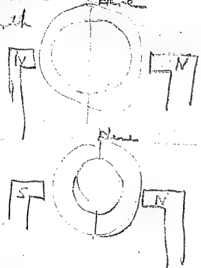
5 H.P. 6 H.P.

Friction 2 H.P. $\frac{8.0}{.6}$

4 H.P.

4 times Current 13.

Rotating eff irons
ring soft as magnetism
as when still when
between the two poles as
North None



Still none
Rotating same
Perhaps the covering of brass
carried the currents & formed the
Not so the same with out a letter.

Wallace

3 Hp Traction 20
4/5 1 Hp Current

6 HP 4

8 80

4
10

8. 14 Hp 3.5) 1200 (1200
3500
280

Siemens

Hp 8) 14000 (1
8000
6000

Hp. 2) 1200
600

1750

600
1200
1750

Electro Magnet

Wire 0,0033 Metre
Weight of ca. 24. Kilo

Coil
Weight of wire wound
14 Kilo

Diameter of wire 0,0026 Metre

Magnet 0.0038 Metres

Weight 14,30 Kilo

Coil Diameter 0.002
Weight 4-25

.02

.09

48

The combustion of a cu. ft of common gas will heat 65 Gallons of H_2O 10°

Hanwell.

---

65 Gallons 1 Gal = 8.32 Lbs

8.32
65

4160
4992
540.80 Lbs

5 cu. ft. a hour for one burner

270400

772 Ft. lbs. for 1° Fahr.

2704
772

5408
3778 [sic]
18928

2,087,488 ft. lbs.

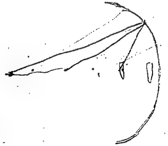
2.087.488

33.000
60

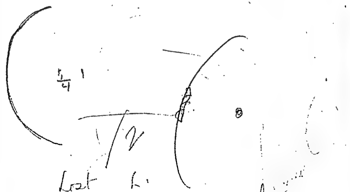
1,980,000) 2,087,488 (1.07
1980000
1.0704880

5 cu. ft per hour

1 Gas burner would drive if all its heat could be used a one horse power engine with a little to spare



Mirror 1 in radius.



1/4

1/2

Lost L.

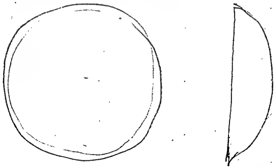
96. 4 90.

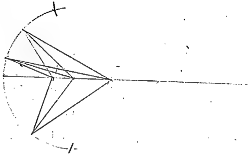
1/2

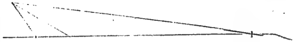
1/16

8

92







6 ft $8\frac{1}{2}$ in

4 wires No. 36

6 ft $8\frac{1}{2}$

4

30 90. 6.66

6.7

6.7) 90.0 (13.

67

230

211

90

6 ... 2 ff ?

15

47

Lamp

Gramme machine

1 Ohm

One inch incandescent Pt will give light equal to one gas burner.
Therefore to have six lights per horse power, a machine using one horse power must heat a wire ~~of~~ with five inches of surface white hot.

Iron wire 0.017 in diam.

7 feet

12
7
84
.053
252
420
4.452

~~017~~
3.14
.017
2198
314
.05338
7

3.14
.017
2198
314
.05338
84
212
424
4.452

2 candle 10 cells
260 260
26
2
15) 52
3

$\boxed{\text{2 candle}}$

Four iron wires .017 in in diametre were heated to a dull red by the Gramme machine. Their resistance was estimated at $\frac{1}{2}$ Ohm and their surface at 15 inches

✓

400 lbs for 24 hours heating building

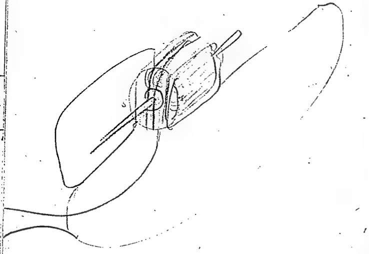
~~1200~~
1200 lbs for the engine working 12 hours ~~at~~ giving about 10 horse power

10 lbs per hour

$4.30 for 2200

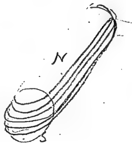
2200) 4,30.~~30~~ (.002 1/5 ct
4400

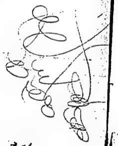
1/5 ct per lb



6.5 4
8
54.0

6.

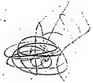




54
12
108
54
648

.017

3.14
.017
2198
314
.05338
648
42644
2132
3198
345384



136.

$\boxed{50}$

54

24

55

99.1 : 1

41

6/1.100
.183

46+6" of 33 coppui

46 / 99 = +

99 : 1 9.9/46.00 / .5

99.1 : 1 :: 46.5 : .4 7/18

9.9/46.50 / .47
39 64
.6869
6939

54

47
16

56

Jan. 13. 1879

Jablochkoff

$2\frac{1}{2}$ h.p. 50.
Carbon 100
150.

Light unopposed 3500 candles
modified 1750 cands.
in – 5 places.

E

15 h.p.
Cost 150, –

Total light 13.50.

Distribution 90 ats 15

15
90
1350

1350
450
E 1800,
Jabk. 1750,

$\frac{1}{2}$ Jablochkoff costs $2\frac{1}{2}$ H.P. 57

say 25 cts. for power
50 cts " Carbon
75 cts.

will pay for $7\frac{1}{2}$ H.P.

$7\frac{1}{2}$

Jan. 13 6 lights per horsepower
45
2 Glass globes round the Jablochkoff
90 Lamps

15
6
90.

90
15
1350 candles

$2\frac{1}{2}$ Jab =
= 2500

But 1350 candles can be
distributed add $\frac{1}{3}$ 1700
or more

Labor not counted

Jan 13

,24

3.14
.33
2

3.14
.24
1256
628
.6536

16)5.0(31
48
20

3.14
.31
314
942
.9734

1.00

~~24 inches~~

Gas costs . say 1.00 per 1000 ft
1 ct per 10 ft

~~1.5 cts per 15 ft~~ ~~or~~ ~~per [illegible]~~
.5 ct per 5 ft

~~H.P.~~ cost $\frac{4}{5}$ ct per hour
say 1 ct per hour

2 lamps per horse
power would pay

Jan 16

$\frac{13}{5}$ row 4 each

when red hot $5 \times 4 = 20$
ohms in each

$\frac{20}{13} = 1.54$ = Resistance in all

$$\begin{array}{r} 13 \overline{)20}\ (1.54 \\ 13 \\ \hline 70 \\ 65 \\ \hline 50 \end{array}$$

Belt for two horse power

$8 \overline{)56}$ Lamps heated
$\quad 7$ 8 times as much for incandescence

$3\frac{1}{2}$ per horse power

Jan. 15 1.300 6000 ft

~~346~~ mm

Yellow bright

620 mm heated

on ~~Bright~~ Green red when 13 mm

given spectral line in multiple area

with 9.8

$$\begin{array}{r} 9.8 \\ 4.1 \\ \hline 98 \\ 392 \\ \hline 40.18 \end{array}$$

$$150 \overline{)620} \; (4.1$$
$$\begin{array}{r} 600 \\ \hline 200 \end{array}$$

499

$$\begin{array}{r} 4.1 \\ 500 \\ \hline 2050.0 \end{array}$$

2050 energy given off on 620 mm wave

$$\begin{array}{r} 620 \text{ mm} \\ 4 \\ \hline 24.80 \end{array}$$

$$\begin{array}{r} .004 \\ 3.14 \\ .004 \\ \hline .01246 \end{array}$$

$$\begin{array}{r} 248 \\ .0124 \\ \hline 992 \\ 496 \\ 248 \\ \hline .30752 \end{array}$$

Yellow

150) 380 (2.5
200
80

11.
2.5
55
22
270

White

150) 220 (1.46
150
700
600
~~1000~~
900

18.5
1.46

Duncan

150) 193 (1.2
150
430
300
130

1.2

172.0
1.2
344 0
172 0
206.40

Melts 172 mm

6.39
1.2
1278
639
7.668

Cold

639
4.1
639
2529
25.930

Piece wire - pt. 440 mm long - wire flattened into
a .66mm - weight after cleaning & bei momentary
incandescence, 0.3430, grammes. We now
[illegible] it in Gramme's machine for 3
[illegible] —

Silicium or Silicon =

Watts p. 267 Vol V

Obtained in free state by action of reducing agents on the chloride ~~and~~ or fluoride and assume the 'amorphous' 'graphitoidal' or crystalline state according to the mode of separation.

Amorphous Si is brown powder, non conductor fuses at melting point of steel in an non oxidising atmosphere.

Graphitoidal: —

May be heated to whiteness in O. without undergoing any alteration in weight. I wonder whether this is a conductor.

Made by fusing 1 pt Aluminium 5 pts glass free from lead 10 pts powd. Cryolite together, treat the mass with HCl, then with Hydrofluoric Acid

Graphite Silicium Try this

Fuse in Hessian crucible

5 parts Soluble glass (Potassium Silicate)
10 parts Cryolite (Sodium + Al fluoride)
1 part Aluminium

Treat the button with HCl. Si remains in shape of scaly crystals, like graphite. It is infusible Fowne 210

.0143 To be multiplied by the square root of the numerals

.000162 To be multiplied by the numerals

.001208 To be multiplied by the square of the numerals

Divide the last product by four. (4)

4) .125
.31 1/4

(2)

$$\begin{array}{r} .0143 \\ 1.41 \\ \hline 0143 \\ 0572 \\ .0143 \\ \hline .020163 \end{array} \qquad \begin{array}{r} .000162 \\ 2 \\ \hline .000324 \end{array}$$

$$\begin{array}{r} \cancel{.0125} \\ \cancel{4} \\ \hline .0500 \end{array} \qquad 4\,)\,.0500 \;\; .0125$$

$$\cancel{\begin{array}{r} .001208 \\ 4 \\ \hline .004832 \end{array}} \qquad \cancel{4\,)\,.004832 \;\; .001208}$$

(3)

$$\begin{array}{r} .0143 \\ 1.73 \\ \hline 0429 \\ 1001 \\ 0143 \\ \hline .024739 \end{array} \qquad \begin{array}{r} .000162 \\ 3 \\ \hline .000486 \end{array}$$

$$\begin{array}{r} \cancel{1.001208} \\ 9 \\ \hline .010872 \end{array}$$

$$\cancel{4\,)\,.010872 \;\; .002718}$$

$$\begin{array}{r} .0125 \\ 9 \\ \hline \end{array}$$

$$4\,)\,.01125 \;\; .00281\tfrac{1}{4}$$

76

(4)

.0143 × 2 = .0286

.000162 × 4 = .000648

.0125 × 16
0750
0125
.02000

4) .02000 = .00500

~~.001208 × 16~~
~~007248~~
~~001208~~
~~.019328~~

~~4) 0.019332 = 0.004833~~

(5)

.0143 × 223
0429
0286
0286
.031889

.000162 × 5 = .000810

.0125 × 25
.0625
0250
0.3125

~~.001208 × 25~~
~~006040~~
~~002416~~
~~0.030200~~

~~4) 0.030200 = 0.007550~~

4) 0.3125 = 0.0781 $\frac{1}{4}$

(6) 77

.0143 × 244
0572
0572
0286
.034892

.000162 × 6 = .000972

.0125 × 36
.0750
0375
0.4500

4) 0.4500 = 0.1125

(7)

.0143 × 2.64
0572
0858
0286
.037752

.000162 × 7 = .001134

.0125 × 49
.1125
0500
0.6125

4) 0.6125 = 0.1531 $\frac{1}{4}$

(8)

.0143
2.82
0286
01144
0286
.040326

.000162
8
.001296

.0125
64
0500
0750
0.8000

4) 0.8000
0.2000

X

(9)

.0143
3
.0429

.000162
9
.001458

.0125
81
0125
1000
101125

4) 1.0125
0.2531 1/4

(10)

.0143
3.16
0858
0143
0429
.045188

.000162
10
0.001620

.0125
100
01.2500

4) 1.2500
0.3125

X

(11)

.0143
3.31
0143
0429
0429
047333

.000162
11
000162
000162
0.001782

.0125
121
0125
0250
0125
1.5125

4) 1.5125
0.3781 1/4

(12)

```
 .0143
  3.46
 ------
  0858
 0572
0429
 ------
.049478
```

```
 .000162
      12
 --------
 000324
000162
 --------
0.001944
```

```
 .0125
   144
 ------
  0500
 0500
0125
 ------
01.8000
```

```
4) 0.18000
   0.04500
```

(13)

```
 .0143
   360
 ------
 085800
0429
 ------
.051480
```

```
 .000162
      13
 --------
 000486
000162
 --------
0.002106
```

```
 .0125
   169
 ------
  1125
 750
125
 ------
2.1125
```

```
4) 2.1125
   0.528 1/4
```


(14)

```
 .0143
  3.74
 ------
  0572
 1001
0429
 ------
.053482
```

```
 .000162
      14
 --------
 000648
000162
 --------
0.002268
```

```
 .0125
   196
 ------
  0750
 1125
0125
 ------
02.4500
```

```
4) 02.4500
   00.6125
```

```
 .0143
  3.87
 ------
  1001
 1144
0429
 ------
.055341
```

```
 .000162
      15
 --------
 000810
000162
 --------
0.002430
```

```
 .0125
   225
 ------
  0625
 0250
0250
 ------
02.8125
```

```
4) 02.8125
   00.7281 1/4
```

(16)

.0143 × 4 = .0572

.000162 × 16
000972
000162
0.002592

.0125 × 256
0750
0625
0250
03.20000

4)03.200
00.800

(17)

.0143 × 4.12
0286
0143
0572
.058916

.000162 × 17
001134
000162
0.002754

.0125 × 289
1125
1000
0250
03.6125

4)03.6125
00.9031¼

(18)

.0143 × 4.24
0572
0286
0572
.060632

.000162 × 18
001296
000162
0.002916

.0125 × 324
0500
0250
0375
04.0500

4)04.0500
01.0125

(19)

.0143 × 4.35
0715
0429
0572
.062205

.000162 × 19
001458
000162
0.003078

.0125 × 361
0125
0750
0375
04.5125

4)04.5125
01.1281¼

(20)

.0143
4.47
1001
0572
0572
.063921

.000162
20
0.003240

.0125
400
05.0000

4)05.0000
01.2500

(21)

.0143
4.58
1144
0715
0572
.065494

.000162
21
.000162
000324
0.003402

.0125
4.41
.0125
0500
0500
05.5125

4)05.5125
01.3781 1/4

(22)

.0143
4.69
1287
858
0572
.067067

.000162
22
000324
000324
0.003564

.0125
484
.0500
1000
0500
06.0500

4)06.0500
01.5125

(23)

.0143
4.79
1287
1001
0572
.068497

.000162
23
000486
000324
0.003726

.0125
529
1125
0250
0625
06.6125

4)06.6125
01.6531 1/4

(24)

.0143
4.89
1287
1144
0572
.069927

.000162
24
000648
000324
0.003888

.0125
576
0750
0875
625
7.2000

4)7.2000
1.8000

(25)

.0143
5
.0715

.000162
25
000810
000324
0.004050

.0125
625
0625
0250
0750
07.8125

4)7.8125
$1.9531\frac{1}{4}$

(26)

~~.0143~~
~~5.10~~
~~1287~~
~~0715~~
~~.072787~~

.0143
5.10
.01430
0715
.072930

.000162
26
000972
000324
0.004212

.0125
676
0750
0875
0750
08.4500

4)08.4500
02.1125

(27)

.0143
5.20
02860
0715
.074360

.000162
27
001134
000324
0.004374

.0125
729
1125
0250
0875
09.1125

4)09.1125
$02.2781\frac{1}{4}$

(28)

.0143
5.30
04290
0715
.075790

.000162
28
001296
00324
0.004536

.0125
784
500
1000
0575
09.8000

4) 09.8000
02.4500

(29)

.0143
5.40
05720
0715
.077220

.000162
29
001458
000324
0.004698

.0125
841
0125
0500
1000
10.5125

4) 10.5125
2.6281/4

(30)

.0143
5.47
1001
0572
0715
.078221

.000162
30
0.0004860

.0725
400
11.2500

4) 11.2500
2.8125

(31)

.0143
556
0858
0715
0715
079508

.000162
31
000162
000486
0.005022

.0125
961
0125
0750
1125
12.0125

4) 12.0125
3.0031/4

(32)

.0143
5.65
0715
0858
0715
.080795

.000162
32
000324
000486
.0005184

.0125
1024
0500
0250
0125
012.8000

4)012.8000
003.2000

(33)

.0143
5.14
0572
1001
0715
.082082

.000162
33
000486
000486
0005346

.0125
1089
1125
1000
0125
013.6125

4)013.6125
003.4031$\frac{1}{4}$

(34)

.0143
5.83
0429
1144
0715
.083369

.000162
34
000648
000486
0.005508

.0125
1156
0750
0625
0125
0125
014.4500

4)014.4500
003.6125

(35)

.0143
5.91
0143
1287
0715
.084513

.000162
35
000810
000486
0005670

.0125
1225
0625
0250
0250
0125
015.3125

4)015.3125
003.8281$\frac{1}{4}$

(36)

.0143
6
.0858

.000162
36
000972
000486
0005832

.0725
1296
0250
0225
0250
0125
0162000

4)0.162000
0040500

(37)

.0143
60
01430
0858
087230

.000162
37
001134
000486
0005994

.0125
1369
1125
0750
0375
0125
0171125

4)017.1125
004.2781 $\frac{1}{4}$

(38)

.0143
6.16
0858
0143
0558
.088088

.000162
38
001296
000486
0006156

.0125
1444
0500
0500
0500
0125
018.0500

4)018.0500
004.5125

(39)

.0143
6.24
.0572
0286
0858
.089232

.000162
39
001458
000486
0006318

.0125
1521
0125
0250
0625
0125
019.0125

4)019.0125
004.7531 $\frac{1}{4}$

94

(40)

.0143
6.32
0286
0429
0858
.090376

.000162
40
0006480

.0125
1600
075000
0125
020,0000

4)020.000
05.000

(41)

.0143
6.40
05720
0858
.091520

.000162
41
000162
000648
0006642

.0125
1681
0125
1000
0750
0125
021.0125

4)021.0125
005.2531 $\frac{1}{4}$

(42) 98

6

.0143
6.48
1144
0572
0858
.092664

.000162
42
000324
000648
0.006804

.0125
1764
500
0750
0875
0125
022.0500

4)022.0500
005.5125

$\frac{18}{16}$

43

.0143
6.55
0715
0715
0858
093665

.000162
43
000486
000648
0.006966

.0125
1849
1125
0500
1000
0125
023.1125

4)023.1125
005 7781 $\frac{1}{4}$

(44)

.0143
6.63
429
0858
0858
.094809

.000162
44
000648
000648
0.007128

.0125
1936
0750
0375
1125
0125
0242000

4)024.2000
006.0500

(45)

.0143
6.70
10010
0858
.095810

.000162
45
000810
000648
0.007290

.0125
2025
0625
0250
0250
0253125

4)025.3125
06.3281$\frac{1}{4}$

(46)

.0143
6.78
1144
1001
0858
09.6954

.000162
46
000972
000648
0.007452

.0125
2116
750
0125
0125
0250
026.4500

4)026.4500
06.6125

(47)

.0743
6.85
0715
1144
0858
097955

.000162
47
001134
000648
0.007614

.0125
2209
1125
0250
0250
027.6125

4)027.6125
006.9031$\frac{1}{4}$

(48)

.0143	.000162
6.92	48
0286	001296
1287	000648
0858	0.007776
.098956	

.0125
2304
0500
0375
0250
28.0000

4)028.8000
007.2000

(49)

.0143	.000162
7	49
.1001	001458
	000648
	0.007938

.0125
2401
0125
0500
0250
030.0125

4)030.0125
007.5031 1/4

(50)

.0143	.000162
7.07	50
1001	0.008100
1001	
.101101	

.0125
2500
062500
0250
031.2500

4)031.25000
007.8125

(51)

.0143	.000162
7.14	51
0572	000162
0143	000810
1001	0.008262
.102102	

.0125
2601
.0125
0750
0250
032.5125

4)032.5125
008.1281 1/4

52

.0143
7.21
0143
0286
1001
103103

.000162
52
000324
000810
0,0084.24.

.0125
2704
500
875
250
0336000

4) 033.8000
008.45000

53

.0143
728
44
0286
1001
.104104

.000162
53
000486
000810
0,008586

01
41

.0125
2809
1125
000
0250
035.1125

4) 035.1125
008.7781 $\frac{1}{4}$

54

.0143
7.34
0572
0429
1001
104962

.000162
54
000648
000810
0,008748

.0125
2916
0750
0125
1125
0250
036.4500

4) 0364500
009.1125

55

.0143
7.41
.0143
0572
1001
.105963

.000162
55
000810
000810
0,008910

.0125
3025
625
0250
0375
.037.8125

4) 037.8125
009.4531 $\frac{1}{4}$

(56)

·0143
7.47
1144
572
·1084
·106964

·000162
56
000972
000816
0.009072

·0125
31.38
0750
0375
0125
0375
0392000

4) 039.2000
009.8000

(57)

·0143
7.54
572
715
1001
·107822

·00.0162
57
0001134
000810
0.009234

·0125
3249
1125
0500
0250
0375
0406125

4) 040.6125
010.1531¼

(58)

0.88171
1.03931

1.76843
3.97373

3.52686
1.62376

(58) ·1088 ~~·1094~~

0.88171
1.03931
1.03886

1.76543
3.97373

·009396 ~~·0094014~~
3.97294

3.52686
1.62376
1.62377

4205 ~~42.13~~
10.51

(59) ·1103

0.885426
1.043026
1.042580

·009558 ~~·0095753~~
3.981152
3.980367

4 / 43.512
10.877

3.541704
1.638604
1.638614

(60)

~~.1135~~ .1112 1.889015
1.046675
1.046229

~~.009773~~
.009720 1.778151
3.988457
3.987666

4|45.00 ~~44.999~~ 3.556302
1125 1.908202
1.653212

61. .1121 ~~.1123~~ 0.892665
1.050265
1.049819

.009882 ~~.0099~~ 1.788389
3.995630
3.994845

4|46.51 3.570660
1162 1.667560
1.667570

(62)

.1130 ~~.1132~~ 0.896196
1.053796
1.053350

.01004 ~~.010062~~ 1.782392
2.002692
2.001907

4|48.05 3.584784
12.01 1.681684
1.681694

(63)

.1139 ~~.1141~~ 0.899670
1.057270
1.056824

.01020 ~~.010200~~ 1.799341
2.009641
2.008856

4|49.61 3.598682
12.40 1.695582
1.695592

106

(64)

.1148 ~~.1150~~	~~.1152~~	~~0.993090~~
		$\bar{1}$.060690
		$\bar{1}$.066244
.01036	~~.010387~~ 00000.	1.806180
		$\bar{2}$.016480
		$\bar{2}$.015695
4 | 51.20 / 12.80		3.612360
		$\bar{1}$.709260
		$\bar{1}$.709270

(65)

.1157	~~.11586~~	0.988456
		$\bar{1}$.064056
		$\bar{1}$.063610
.01053	~~.010535~~ 100.	1.812913
		$\bar{2}$.023213
		$\bar{2}$.022428
4 | 52.810 / 13.20		3.625826
		$\bar{1}$.722726
		1.722736

(66)

19

.1166	~~.11679~~	0.909772
		$\bar{1}$.067372
		$\bar{1}$.066926
.10.69	~~.010711~~ Coll.	1.819544
		$\bar{2}$.029844
		$\bar{2}$.029059
4 | 54.46 / 13.61	~~54.44.9~~	3.639088
		$\bar{1}$.735988
		1.735998

67

.1175	~~.11766~~	0.919037
		$\bar{1}$.070637
		$\bar{1}$.070191
~~.01087~~ .01085	~~.010864~~ 811100.	1.826075
		$\bar{2}$.036375
		$\bar{2}$.035590
4 | 56.11		3.652150
		$\bar{1}$.749050
		1.749060

(68)

~~.11854~~ .11845   0.916254

5.4.917.3854

1.073408

~~.01102~~ .01103   1.832509

2.042809

2.042024

4 | 57.80   ~~57.799~~   13.665018

14.45   1.761918

1.761928

(69)

.1193 ~~.11841~~   0.919424

1.077024

.01117 ~~.001198~~   1.838849

2.049149

2.048364

ok

4 | 59.51   3.677698

14.87   1.774598

1.774608

(70)

~~.1193~~ ~~.12027~~   0.922549

.1201   1.080149

1.079703

.01134   ~~.001161~~   1.845098

2.055398

2.054613

4 | 61.25   ~~61.249~~   3.690196

15.31   1.787096

1.787106

(71)

.1210   ~~.12112~~   0.925629

1.083229

1.082783

.01150   ~~.001152~~   1.851258

2.061558

2.060773

4 | 63.0   3.702516

15.75   1.799416

1.799426

110 (72)

.1218 ~~.12198~~ 0.928666
1.086266
1.085820

.01166 ~~.0011679~~ 1.857332
2.087632
2.066847

4/64.80 ~~64798~~ 3.714664
16.20 1.811564
1.801574

(73)

.1226 ~~.12281~~ 0.931661
1.088261
1.088815

.01182
~~.0011824~~ 1.863323
2.073623
2.072838

4/66.6 3.726646
16.65 1.823546
1.823556

(74) 111

.12360 0.934616
1.092216
1.091770

~~.01201~~ 1.869232
.01198 2.079532
2.078747

4/68.45 ~~68.442~~ 3.738464
17.11 1.835364
1.835374

(75)

.1243 ~~.1244~~ 0.937530
1.095130
1.094664

.01217
~~.0012172~~ 1.875061
2.085361
2.084576

~~70.31~~ 3.750122
4/70.31 1.847022
17.57 1.847032

112

(76)

.1251 ~~.12532~~ 0.940407

$\bar{1}$.098007

$\bar{1}$.097561

3 3 3 3 3 3

3 3

~~.012004~~

.01231 1.880814

2.091114

2.090329

4 | 72.20 ~~72.55~~ 3.761628

18 05 1.858528

1.858538

(77)

.1260 ~~.12614~~ 0.943245

$\bar{1}$.100845

$\bar{1}$.100399

.012474 ~~.012496~~ 1.886491

2.096791

$\bar{2}$.096006

3.772982

4 | 74.1126 1.869882

18 52 1.869892

110

(78)

.1268 ~~.1268~~ 0.946047

$\bar{1}$.103647

$\bar{1}$.103201

3

.01263 1.892095

$\bar{2}$.102395

2.101610

4 | 76.02 3.784190

19.01 1.881090

1.881100

(79)

.1276

~~.1277~~ 0.948813

$\bar{1}$.106413

$\bar{1}$.105967

.01279 1.897627

$\bar{2}$.107927

$\bar{2}$.107142

4 | 78.01 3.795254

19 50 1.892154

1.892164

(80)

.128 ~~12834~~

0.951545
1.109145
1.108699

.012968

1.903090
2.113390
2.112605

~~79.20~~
4/80.00
20.00

3.806180
1.903080
1.903090

(81)
found here

.1292

0.954242
1.111842
1.111396

.01312 10.

1.908485
2.118785
2.118000

~~81.99~~ 92
4/82.01
20.50

3.816970
1.913870
1.913880

(82)

.1300

0.956907
1.114507
1.114061

.01328

1.913814
2.124114
2.123329

4/84.05
21.01

3.827628
1.924528
1.924538

(83)

.1308 ~~.1308~~

0.959539
1.117139
1.116693

.01344

1.919078
2.129378
2.128593

4/86.11
21.52

3.838156
1.935056
1.935066

116

(84)

.1316 ..... 0.962139
$\bar{1}$.119739
$\bar{1}$.119243

.01360.. 1.924279
$\bar{2}$.134579
$\bar{2}$.133794

4|88.19 3.848558
22.04 1.945458
1.945468

(85)

.1324.... 0.964709
$\bar{1}$.122309
$\bar{1}$.121863

.01377... 1.929419
$\bar{2}$.139719
$\bar{2}$.138934

4|90.31 3.858838
22.57 1.955738
1.955748

117

(86)

.1332 ..... 0.967249
$\bar{1}$.124849
$\bar{1}$.124403

.01393 .. 1.934498
$\bar{2}$.144798
$\bar{2}$.144013

4|92.45 3.868996
23 1.965896
1.965906

(87)

.1340... 0.969759
$\bar{1}$.127359
$\bar{1}$.126913

.01409... 1.939519
$\bar{2}$.149819
$\bar{2}$.149034

4|94.61 ~~9461~~ 3.879038
23 65 1.975938
1.975948

(88)

.1848 0.972241
$\bar{1}$.129841
$\bar{1}$.129395

.01425 1.944483
$\bar{2}$.154783
$\bar{2}$.153995

4/96.80 3.888966
2420 1.985866
1.985876

(89)

.1855 0.974695
$\bar{1}$.132295
$\bar{1}$.131849

.01442 1.949390
$\bar{2}$.159690
$\bar{2}$.158905

3.898780
1.995680
4/99.21 1.995690
2475

(90)

.1362 0.977121
$\bar{1}$.134721
$\bar{1}$.134275

.01458 1.954243
$\bar{2}$.164543
$\bar{2}$.163758

4/101.25 3.908486
25.31 2.005386
2.005396

(91)

.1369 0.979520
$\bar{1}$.137120
$\bar{1}$.136674

.01476 1.959041
$\bar{2}$.169341
$\bar{2}$.168556

3.918082
2.014982
4/103.5 2.014992
25.87

25.87
10.348

(92)

.1377 — 0.981894
1.139494
1.139048

.01490 — 1.969788
2.174088
2.173303

4 | 105.8
26.45

3.927576
2.024476
2.024486

(93)

.1385 — 0.984241
1.141841
1.141395

.01506 — 1.978483
2.178783
2.177998

4 | 108.1
27.02

3.936966
2.033866
2.033876

(94)

.1393 — 0.986564
1.144164
1.143718

.01522 — 1.973128
2.183428
2.182643

4 | 110.4
27.60

3.946256
2.043156
2.043166

(95)

.1399 — 0.988862
1.146462
1.146016

.01539 — 1.977724
2.188024
2.187239

4 | 112.8
28.20

3.955448
2.052348
2.052358

(96)

.1407 0.991135
$\bar{1}$.148735
$\bar{1}$.148289

.01555 1.982271
$\bar{2}$.192571
$\bar{2}$.191786

4|115.2 3.964542
28.80 2.061442
2.061452

97 .1414 0.993386
$\bar{1}$.150986
$\bar{1}$.150540

.01571 1.986772
$\bar{2}$.197072
$\bar{2}$.196287

4|117.6 3.973544
29.40 2.070444
2.070454

(98)

.1421 0.995613
$\bar{1}$.153213
$\bar{1}$.152767

.01587 1.991226
$\bar{2}$.201526
$\bar{2}$.200741

4|120.00 3.982452
30.0 2.079352
2.079362

(99) .1428 0.997817
$\bar{1}$.155417
$\bar{1}$.154971

.01603 1.995635
$\bar{2}$.205935
$\bar{2}$.205150

3.991270
2.088170
4|122.5 2.088180
30.62

(100)

.1436 ISHI. 1.000000
1.157600
1.157154

.01620 10. 2.000000
2.210300
2.209515

4/12500 4.000000
3125 2.096900
2.096910

100

8.SHI.

2.004321

2.008600

(103)

2.012837

(104)

2.017033

(105)

2.021189

(106)

2.025306

107

2.029384

2.033424

109

2.037426

2.041393

(111)

2.045323

136

(112)

2.049218

(113)

2.053078

(114)

2.056905

115

2.060698

137

132

(116)

2.064458

117

2.068186

118

133

2.071882

119

2.075547

(120)

2.079181

121

2.082785

(122)

2.086360

123

2.089905

136

124

2.093422

125

2.096910

126

2.100371

127

2.103804

137

138

128

2.107210

129 —X—

2.110590

130

2.113943

131 —Y—

2.117271

139

140

132

2.120574

133

2.123852

134

135

2.127105

2.130334

(41)

142

136

2.133539

137

2.136721

(138) 143

2.139879

139

2.143015

140

2.146128

141

2.149219

142

2.152288

143

2.155336

146

144

2. 158362

145

2. 161368

146

2. 164353

147

2. 167317

147

148

2.170262

149

2.173186

150

2.176091

151

2.178977

150

152

2.181844

153

2.184691

154

2.187521

155

2.190332

151

152

156

2.193125

157

2.195900

158

2.198657

159

2.201397

153

160

2.204120

161

2.206826

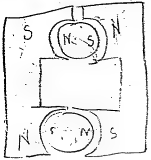
162

2.209515

163

2.212188

164



2.214844

165

2.217484

166

2.220108

167

2.222716

168

2.225309

169

2.227887

170

2.230449

171

2.232996

172

2.235528

173

2.238046

174

2.240549

175

2.243038

176

2.245513

177

2.247973

178

2.250420

179

2.252853

180

2. 255273

181

2. 257679

182 1.079 / 1.125

$\bar{0}.0330$
0.0511
$\bar{1}.9819$
2
$\bar{1}.9638$

92
9
838

2. 260071

183

2.262451

184

2.264818

185

2.267172

186

2.269513

187

2.271842

188

2.274158

189 $\xrightarrow{\times}$

2.276462

190

2.278754

191 $\xrightarrow{//}$

2.281033

192

2.283301

193

2.285557

194

2.287802

195

2.290035

196

2.292256

197

2.294466

198

2.296665

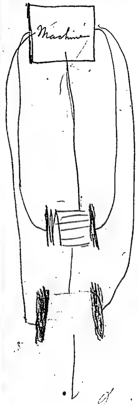
199

2.298853

200

2.301030

L



4 to one

4 to one

4 to one

20 per cent

20

2 2

20 20

20

20 20

20

20 20

10% 10%
10% 10% 10%
10% 10%
10% 100%

3 hours

Central Station
150 for a machine for
25 lights
$6.

Conductor outside Est. 2.
Lamp 3.

1 Lamp capital $11

300 hours a year

~~300)11.00(~~
~~3.66~~ cent

$1.10 interest

300)1.10
.00366

3.66 mills per hour

100 machine 20 lights
45 $25 a HP.
5
8 Boiler
10 Engine $25 a H.P.
87 $25
87
5 $19. $21
40
10
397

$18 a lamp

$18.00

300) 1.80
.006 mills per hour

$19

) 1.90

1.9 0   0,
365   2,

$ 10000000

~~500000000~~ 1000 feet
100,000,000 burners an hour

~~10000000~~
~~1000000000~~

$\frac{1}{10}$

~~1.000000~~

~~500,000,000~~

$ ~~10,000,000~~   ~~1000~~
5 ~~00,000~~   ~~500,000~~

$2

$\frac{\$10}{5}$ $2 a year interest

500,000

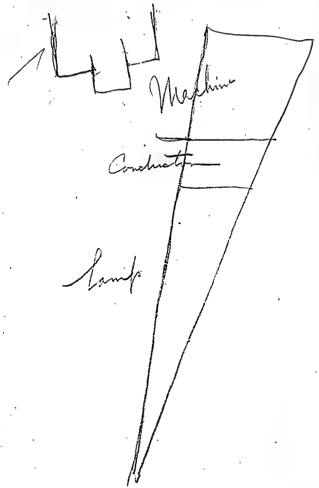
1,000,000

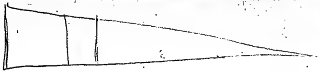
500,000

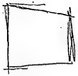
100.000.000

[illegible]

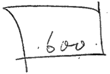
2000000

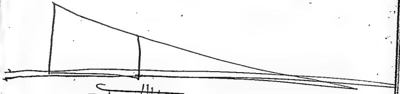


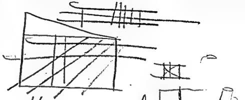




1 House

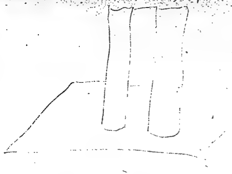






How much

How much will the E.M.F
drop when one lamp in
or many?



1 in 10

1 ohm machine
100 ohm lamp
1 ohm in conductor for
10 lamps

R in Lamp 5 units
R in mach 1 "
line 1/2 unit

5 10
" 2
1
100
13

13)100(78
91
90
78
156
7.8
4

10 5
~~4~~ ~~7~~
1 1
13 2

No. 1
Lamps 10
conductors 1
machines ~~2~~
1~~3~~ units

$12\overline{)100}\,($ ~~8~~3
96
40

83

12 units of

$12\overline{)100}\,($ 8.3

83
8.3
8.3

+8

5	10 lamp
-1	2 Machine
1/2	1 Conductor

13

13) 100 (7.7
91
90

7.7

7.7 lamp
15.4 machines
7.7 Conductor

1/2 Ohm Conductor
1 Ohm machine
100 Ohm lamp

77

77
15
77

23

1 lamp 100 50

1/2

100 = diff 9

50
1
2

103) 1000 (.0097
927
730

2 lamps 97

$53)100(1.88$
53
470
424
46

50 150
1 2
1/2 1

25
1
1/2

50
2
1

1.88
50
9400

103)100.0(97
927
730

53

53)100.0(0.188
53
470
428
420

1.88
50
9400

25
1.
2

3 lamps 94

94

8 Lamps

12.5 lamps
1/2 conductor
1" mask

25
2
2
28)100(356
84
160
140
200
168
32

357
25
1785
714
8825

16 lamps

100

12.5

25	6.25	lamps
2	1/2	conductor
4	1	machine

.31) 100 (322
.93
70
62
80

322
25
1610
644
80.50

1 lamp
1000 99
1 Ohm machine & conductor

2 lamps

50
1
51

51) 100 (196
51
490
459
310
306
40

196
.50
9800

4

25

1

26) 100 (384

78

220

208

120

100

384

9616

~~384~~

8

12,5

1

27) 100 (37

81

190

187

~~26~~

37

25

180

72

900

16)

6,25

1.

7.25

25

4

29) 100 (344

87

130

116

140

3

25

155

62

775

31

(34400

86

4 (37

9.22

20 lamps

5
1
6) 100 (1
166

1.66 ~~6~~
5 7.7
833

83 lamps
8.5 conductor
8.5 machine

1/2 1/2

~~99.3~~ 2

~~100 0.1 ... 100~~

50
1
51

51) 100 (196
51
490
459
310

100
196
98.04

4

25
1
26) 100 (346
88
120
104
160

100
346
9654

218

8 No 13

513

1250 13

or II

8 in series 1 Ohm each

$E = \cancel{64}\ 1$

$\frac{1}{8}$

Magnet strength

$= \frac{1}{8}$

Each magnet Cost $= \frac{1}{64}$.

8 magnets 64 Ohms in multiple arc

in each

$\frac{1}{64}$ = current

$\frac{1}{64} \times 64 = 1$ strength

Cost $\frac{1}{64}$ the same as before while strength of magnet 8 times greater

$$\frac{2\cancel{0}}{700\cancel{0}}$$

700) 2

$\frac{1}{350}$ Weber

$\frac{1}{350} \times \frac{1}{350} \times \frac{20}{\cancel{7000}}$

$\frac{2}{35}$ $\frac{1}{17}$ Erg

1 Ohm 1 cell
2 Ohm

$\frac{1}{4}$ Weber

$\frac{1}{16} \times 4 = \frac{1}{4}$

$\frac{1}{2}$ strength

$\frac{1}{\cancel{350}} \times \cancel{7000}$

20 = Strength of magnet

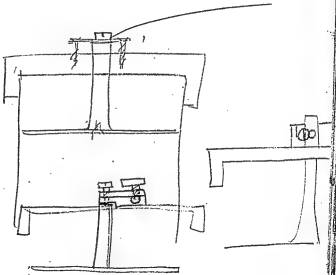
40 times as strong
160 times better

2888
2780
2

.4606
.4440
.0166

Make 3 buttons the old way –

Sat. Sol. Caustic Soda



8
8
1648
443
64
1772
2658

$$28 \overline{)\,2835.2}$$
28
35
28
72

168) 1650 (9
1344
306

168) 1650 (98.2
1592
1380
1344
360

10100 ft lbs

9100

10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10

10000
8250
18250

16.5) 1.000 (

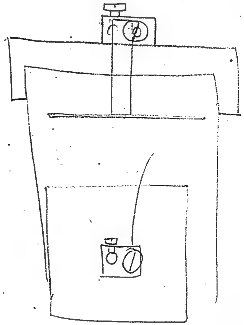
33000
5
165000
1825
47500

165000
18250
183250

183.25) 18.25

165000
8250
173250

173) 1000 (5.2
965
350



1.019 Ohm

1.019 Ohms

Ohm 1.0196 Absolute
Kohlrausch

Of E.M.F measured in Ohm

1.02

$\frac{11.24}{1.02}$

$$\begin{array}{r} 1.0504 \\ .0086 \\ \hline 1.0418 \end{array}$$

11.24 Absolute

1.101

1.125

$8\overline{)9}$
1.125

Armature

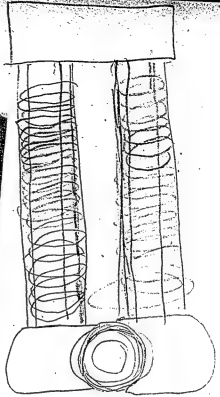
$$1 + \frac{a^2+b^2-c^2}{2ab}$$

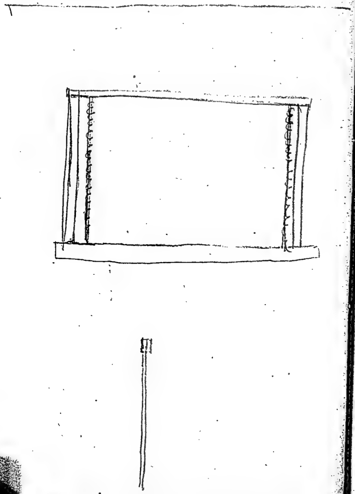
$$\frac{2ab + a^2+b^2-c^2}{2ab}$$

$$a^2+2ab+b^2 = (a+b)^2$$

$$(a+b)^2$$

$$a^2+b^2+2ab$$

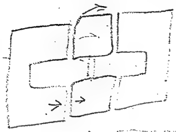


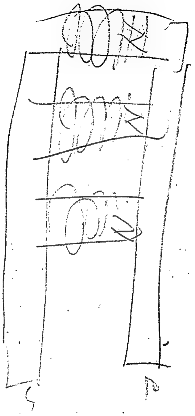


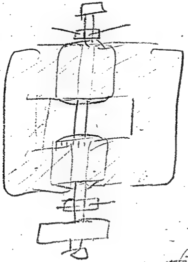
<u>30 : 55</u>

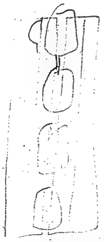
55 : 30 :: 25 :

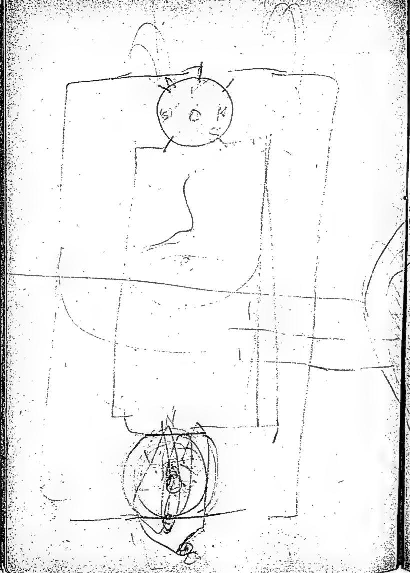
$$\begin{array}{r} 30 \\ 55\overline{)750}\;(13.6 \\ \underline{55} \\ 200 \\ \underline{165} \\ 350 \end{array}$$

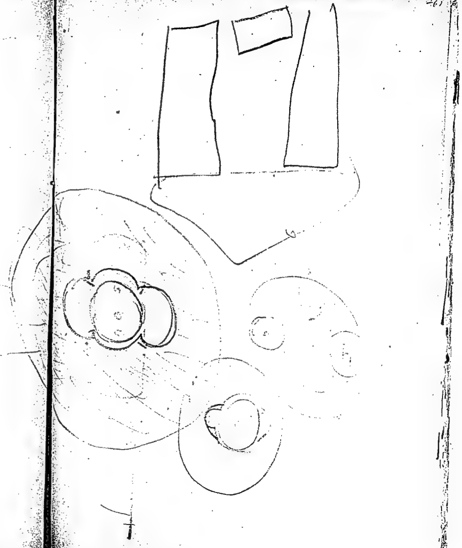


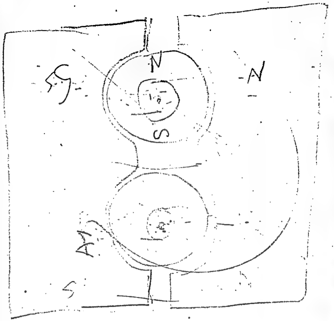


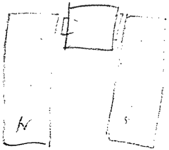


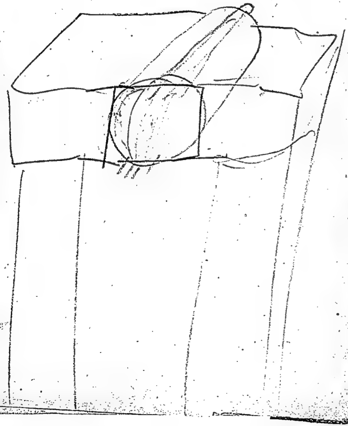


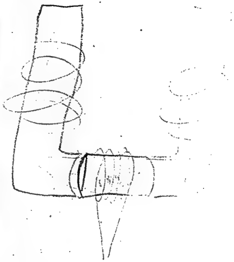





N
S
N
S
N
S


N
S



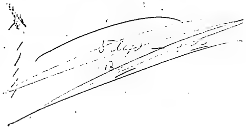


Pages torn out by
Rue batch
not experiment

244

Multiply each numeral by 20 that is 1. 2. 3 4, 5, 6 &c

feet	√	( )÷ Number multiply by [illegible]	$( )^2$ ÷ 7	$( )^2 \div 4$
1. 20				
2. 40				
3. 60				
4. 80				
5. 100				
6. 120				



D.

.01436 [illegible] .000162 [illegible]

$\bar{2}$.157600 $\bar{4}$.210200 [illegible]

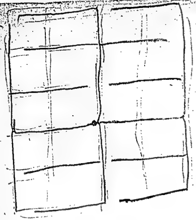
Menlo Park Notebook #7 [N-78-12-11]

This notebook covers the period December 1878-April 1879. The entries are by Edison, Charles Batchelor, and Francis Upton. Almost all of the material relates to experiments on electric lighting. Included are drawings of lamps; notes on filaments; drawings of generators, including one labeled "Edison 1st drawing"; comparisons to gas lighting costs; and calculations for an electric lighting system. There are also notes on chalks for telephones and a drawing of a Gramme machine combined with an induction coil for the telephone. The book contains 282 numbered pages and one unnumbered page.

Blank pages not filmed: 1, 76-77, 226-227, 246-275.

Missing page numbers: 233-234.

2



2000	1
1000	2
500	4
250	8
125	16
62 1/2	32
31 1/4	64
15 3/4	128
7 7/8	256
3 7/8	512
1 7/8	1024
7/8	2048
7/16	4096.

20
.4
160.000 4

600

400 8
18 16
16 32

3

Dec 11 1878

3/8

T A Edison

3/8. 1/8

8 | 3000

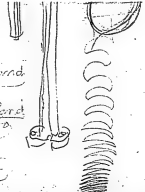
3

Edison Laboratory Note Book No. 7.

Page 3.

Edison's Incandescent Electric Light.
See Edison Patents:

214,636	227,227
214,637	227,228
218,866	227,229



156
25
780
312
3900

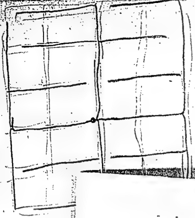
Portland

Portland

46000000

Boston

2



31 1/4	64
15 3/4	128
7 7/8	256
3 7/8	512
1 7/8	1024
7/8	2048
7/16	4096.

6.00

400 8
16 16
16 32

3

Dec 11 1878

3/8

T A Edison

3/8.

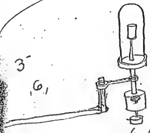
1/8

8) 3000
375

375
5
1875
312.3

3

6,



156.

2000,

156
25
780
312
3900

Portland

Portland

L6oooooooo

Boston

S S

S M T

Boston

Boston Weekly

Griffin Griffin

Griffin Engineering problems Griffin

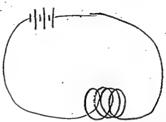
Tower

Engine Railway

Railway Transportation

Griffin

Dec 11 1878



Bohm,

1/10 of cp. 10 ti a Candle 150 ti a gas jet.

.3. 10 cells 1

1 cells to Candle.

64

2 cells and	6 ohm	
4	$1\frac{1}{2}$	6/32
8	12/16	
16	4/16	3/32
32	3/16	
64		

5 5

25 25

11 Cells .2 Ohm

2.2

Dec 13 1878
TAE

$$a = \frac{22}{2.2+5} = 3$$

$$= \frac{22}{7.2}$$

7.2) 22.0 (3.
216
40

$\frac{4}{5}$

$$c = \frac{22}{2.2+25}$$

15

$$\frac{22}{27}$$

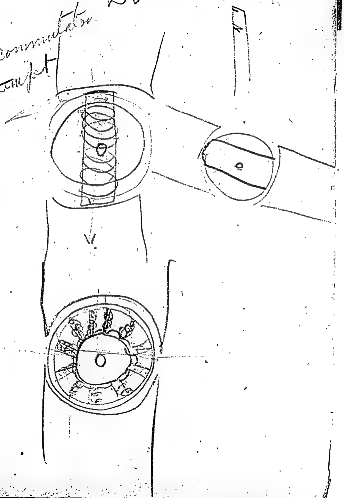
27) 22.0 (.81
216
40.

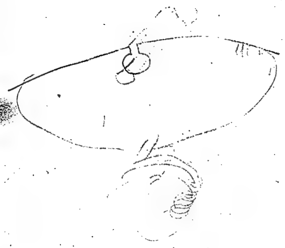
Zcu meter

ages 9 to 27. "Dynamo Sketches" (Unimportant)

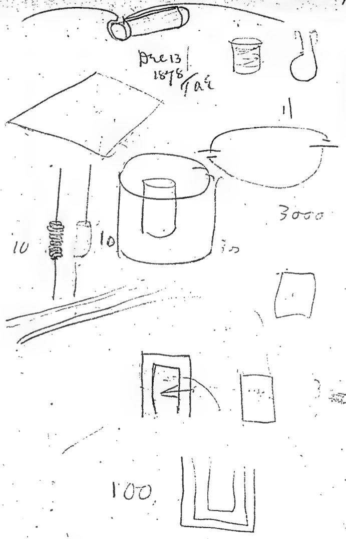
Dec 13 1878 TAE

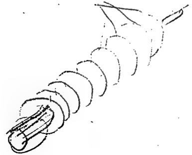
Non commutator attempt

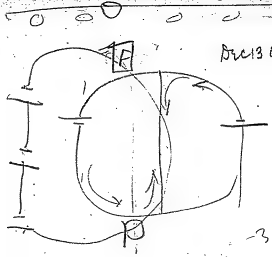




Dec 13 1878 TAE



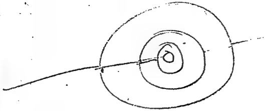


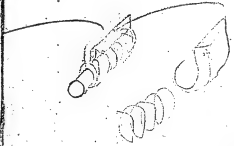


Dec 13 1898
TAE

-3000

30-00



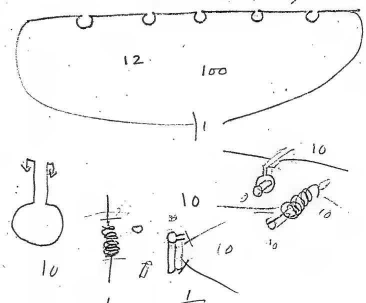


4	$\frac{1}{40}$
~~8~~	

~~10~~

1	$\frac{1}{5}$	10000		2000
2	$\frac{1}{10}$	5000	2	1000
4	$\frac{1}{20}$		4	500
8	$\frac{1}{40}$		8	250
16	$\frac{1}{80}$			125
32	$\frac{1}{160}$		16	62 $\frac{1}{2}$
64	$\frac{1}{320}$		32	31 $\frac{1}{4}$
			64	15
			128	7 $\frac{1}{2}$
			256	3
			512	1 $\frac{1}{2}$
			1024	.62
			2048	31
			4096	15
			8162	

Dec 18 1878 TAE



1 $\frac{1}{50}$ $\frac{1}{41}$

10000	2000
5000	1000
2500	500
	250

1120600
672000

6

2 $\frac{1}{30}$ lb per min

1120 | 196000 | 176 | 600
1120
8400
7840
600

1 = 1 =

Dec 13 1878 TAE

$C = \frac{e}{r}$ $C = \frac{e}{r} = \frac{25}{30} = .83$
$e = \frac{c}{r} = \frac{50}{4}$ 12.50

30 / 25.00 / 0.83

25.

30

1 ton Coal 10000
340 lbs. 10000 70 000

5 ft = 15 candles 60 min 900

70000

5 : 900 70000 900
5 / 63000000
60 / 1.26 00000
210.000

210 000

18

30000 / 39

Electric Light Dec 17 1878

2240
134 Cost gas &c
9.00

~~10000 ft and 9.00~~ coke

1300 lb coal = 10'000 ft gas 1 hr
for one hour
= 2'000 gas jets
= 30'000 candles
= 650 horsepower

650 horsepower = at 600 candles per ~~HP~~ = Jablochkoff candles 390.000 or 13 times more than Gas.

Taking into consideration the consumption of carbon as twice as much as ~~HP~~. P. in Jab. Candle it would be $4\frac{1}{3}$ cheaper than Gas

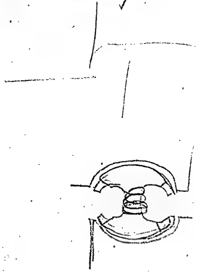
Over

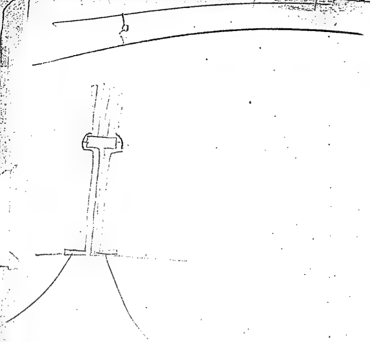
11³ per HP

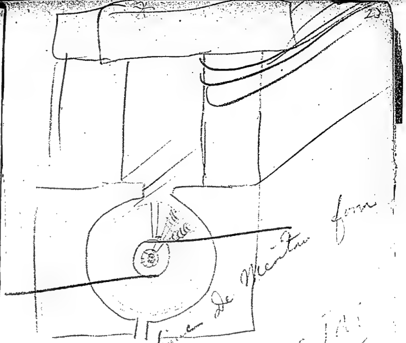
4² = 1 HP 650 90
58500

Electric Light Dec 14 1878

We get 6 lights per HP 17
90 can. per HP we should
have 58500 candles
~~Theoretically 1 HP~~



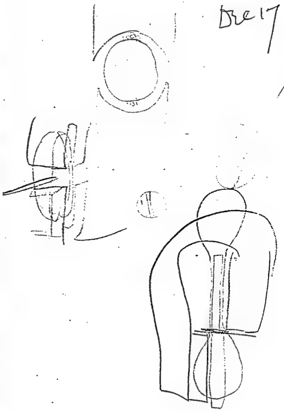




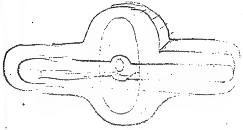
Dynamo machine De Meritens form

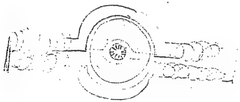
Dec 17 1878 TAE

Dec 17 1878
TAE



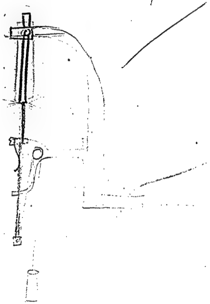
Dec 17 1878
TAE



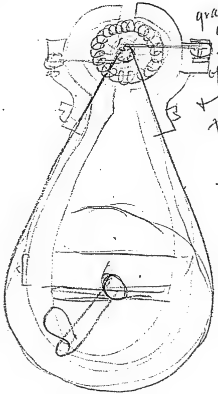


Dec 17 1878
TAE

Sheep Lamps

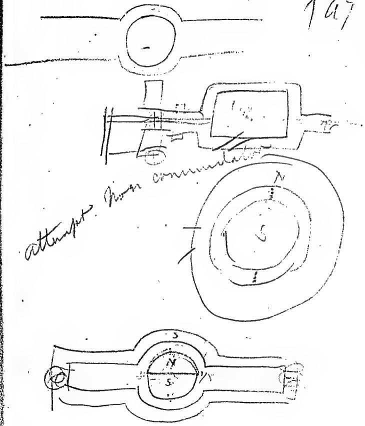


Dec 17 1878
TAE

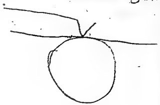


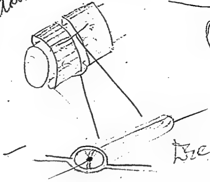
Gramme Mach
combined with
induction coil
of Carbon telephone
& Motophone
Telephone

Dec 19 1878
TAE

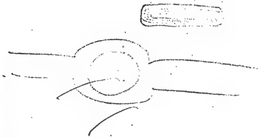


Commutator



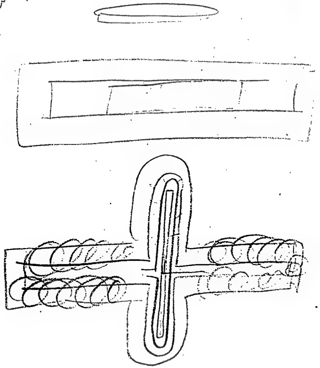


Dec 17 1879.
TAE



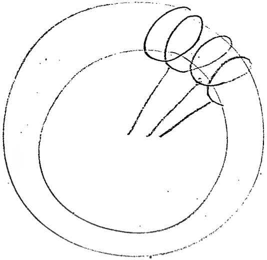
Siemens form of

Dec 17 1878 / JAE



Jne 17 1878
TAE

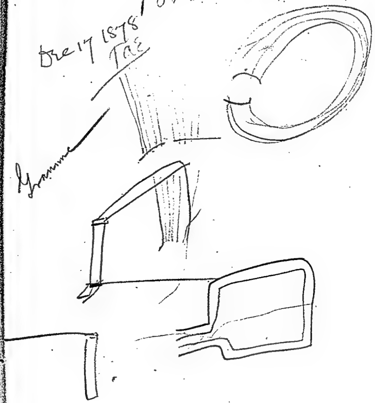
Gramme ring



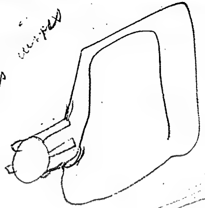
500
1000

.002 cross sect
.001 "

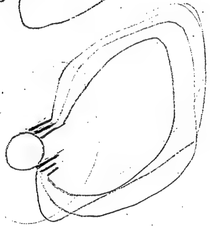
Dec 17 1878
TAE



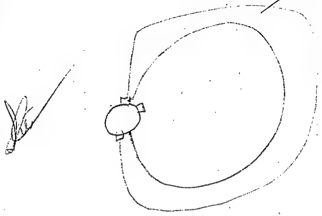
Siemens [illegible]

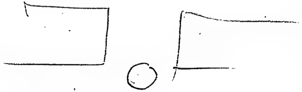


Dec 17 1898
TAE

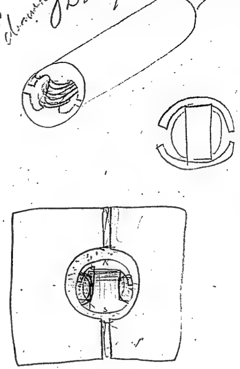


Dec 17 1876 TAE



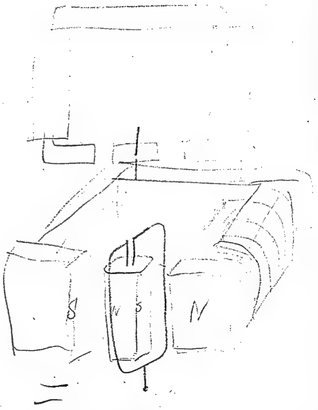


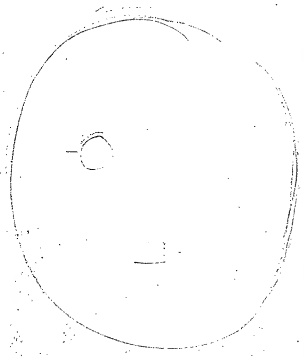
Edison 1st drawing Dec 17 1878 T.A.E



Siemens form of

Dec 17 1878
TAE

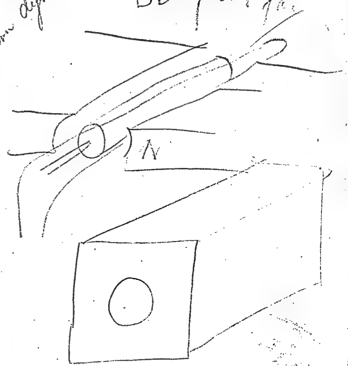


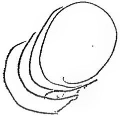


Edison dynamo

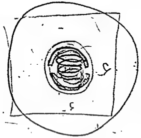
Dec 17 1878

TAE





Edison dignamo



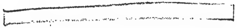
Dec 17 1878
TAE

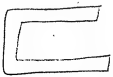
157

3

3 feet 4 inch

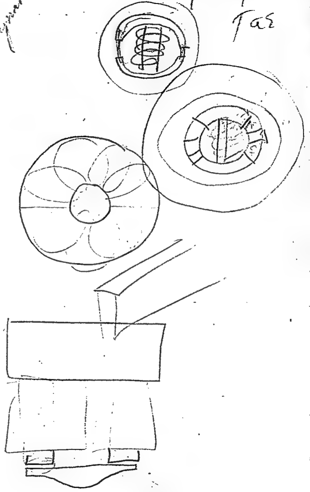
2½





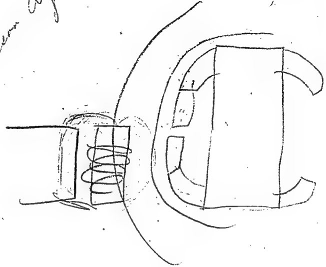
Dec 17 1878
TAE

Edison dynamo



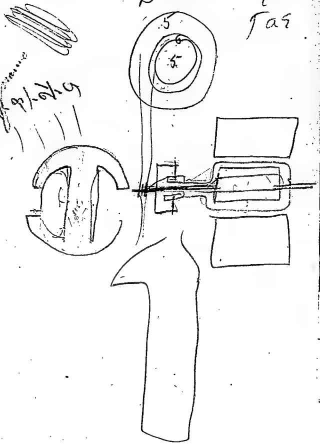
Dec 17 1878
TAE

Edison dynamo

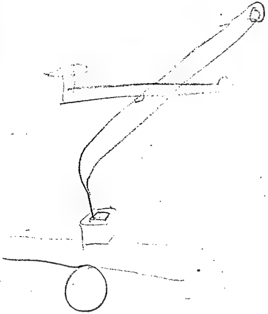


Dec 21 1878

Tas

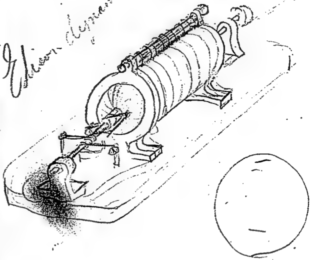


Edison

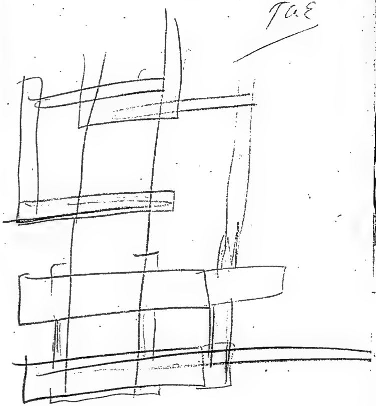


Dec 29 1878

Edison dynamo

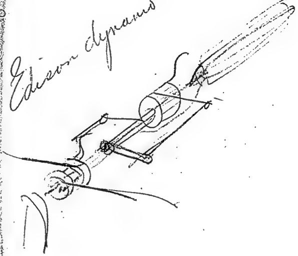


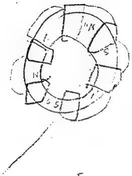
Dec 29 1878
TAE

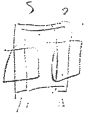


Dec 29 1878
FAS

Edison dynamo





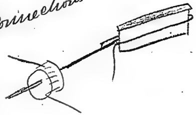


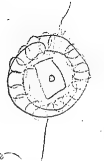
Edison's
Magnet Electric Machine

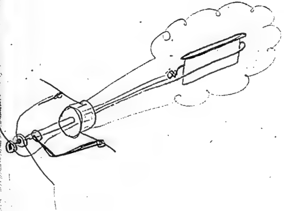
Dec 31st 1878

Chas Batchelor

Connections







Dec 31 1878 Paid

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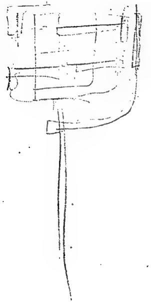

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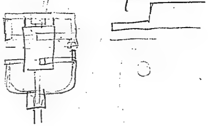
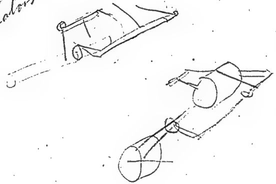
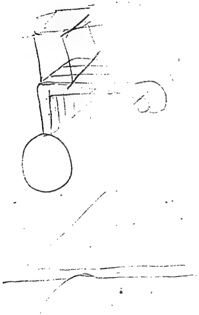


E- dynamo
Commutators





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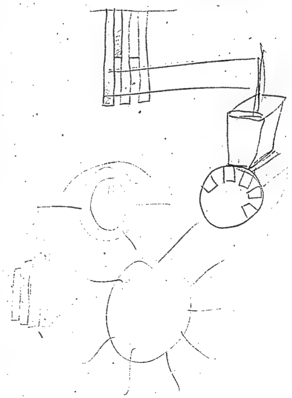
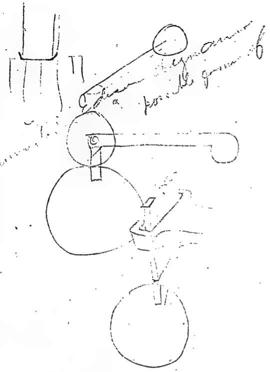
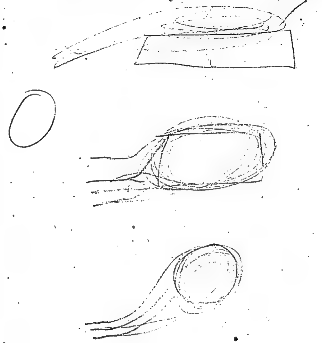




Jan 1 1879 TAE



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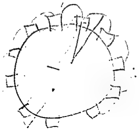

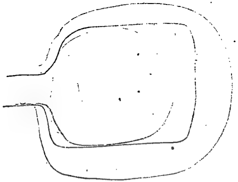

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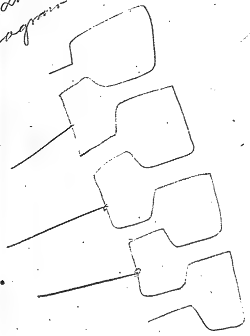
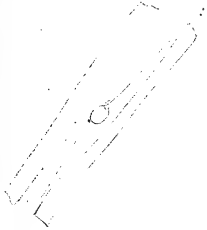
Loops Diagrams





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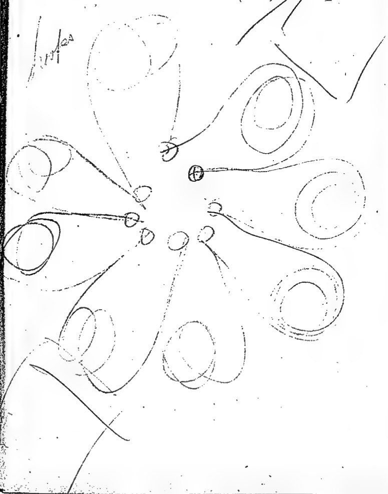

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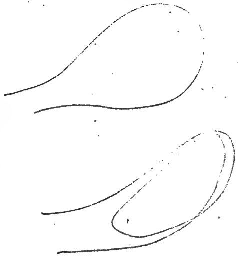

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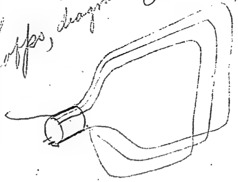
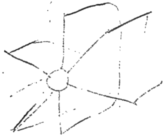
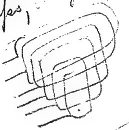
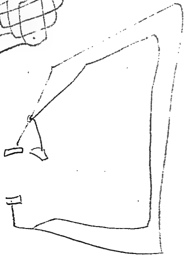
Loops, diagram of

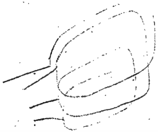




Loops, diagram of







January 1 1879

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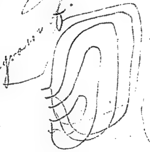
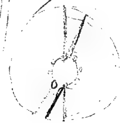
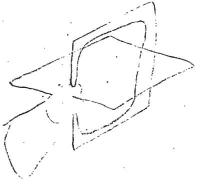
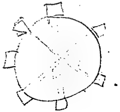
Loops, diagram of









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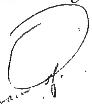

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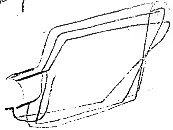
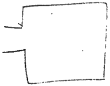
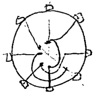
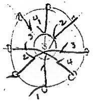




Loops course of currents





Loops connection Jany 1 1879
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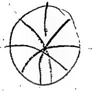

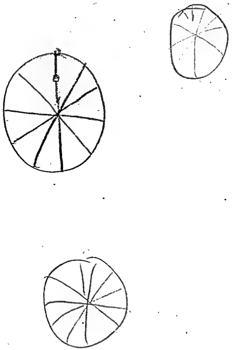

Commutator

Jan 2 1879

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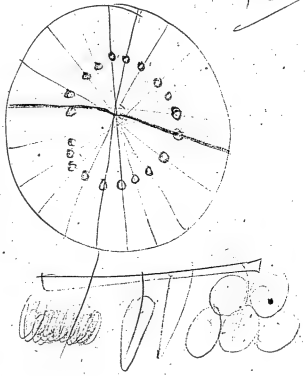
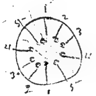


96

Commutation (?) Currents in



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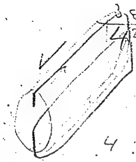

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Jany 2 1879 97
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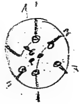
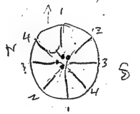
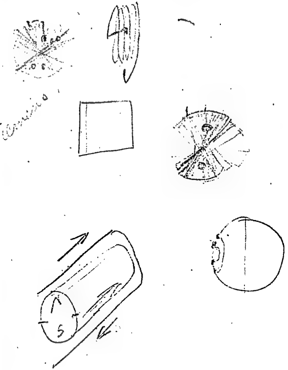
Current in loops





Siemens



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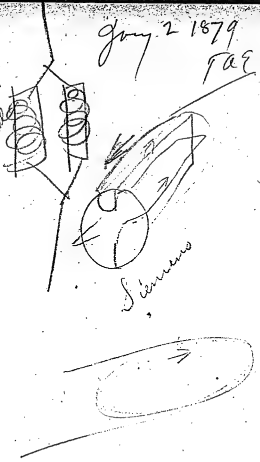
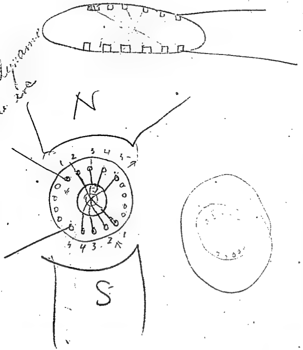
Gramme



Siemens

Jany 2 1878
TAE

Edison dynamo
Multiple etc



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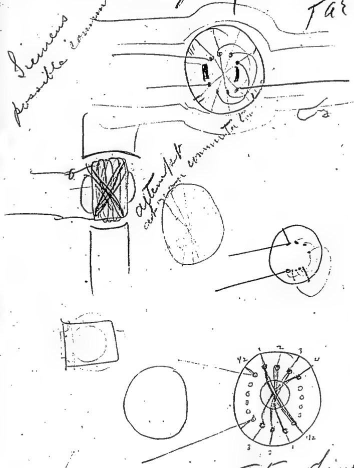
Siemens
possible commutator

attempt at commutator



Commutator Siemens

Jan 2 1879

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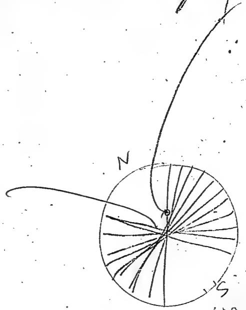
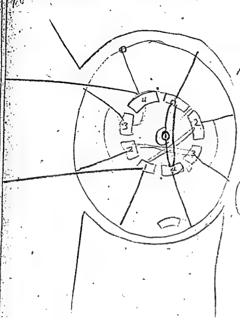


Commutator Lemmas



Commutator possible
Siemens

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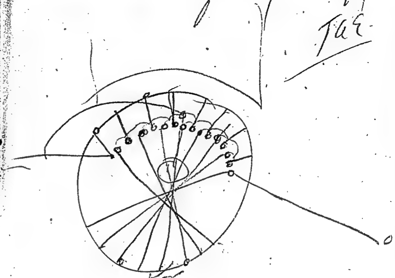
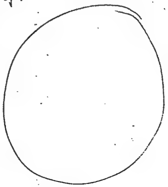


Commutator
possible Siemens.

A Grand Potentiality.



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Jan 2 1879
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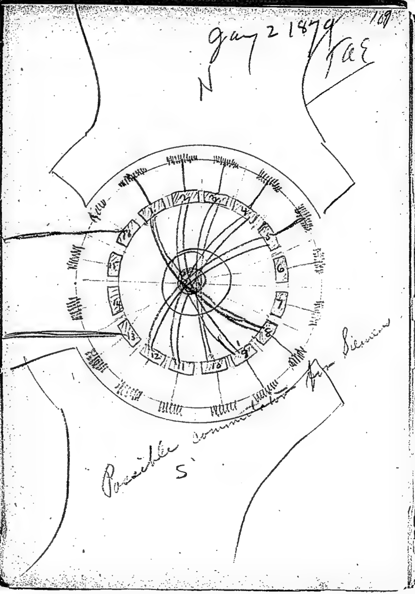

Possible commutator for Siemens
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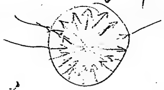
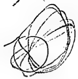
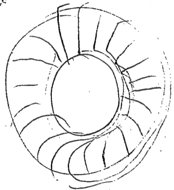
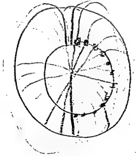
TAE





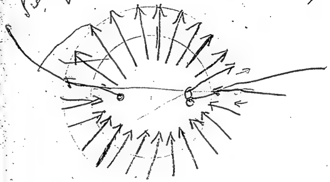
Gramme Siemens
combination

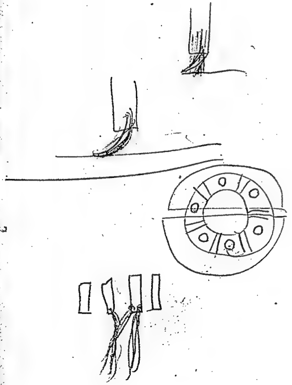




January 2 1879
TAE

Siemens currents in





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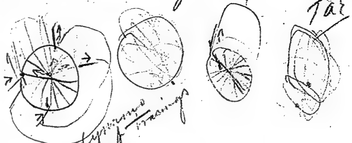
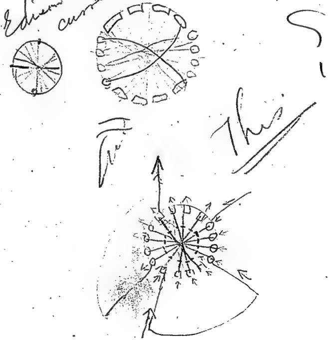
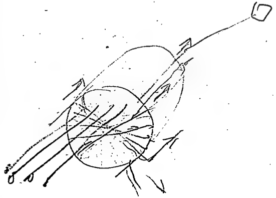
TAE



Edison dynamo current tracings





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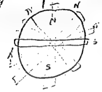

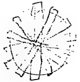

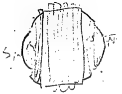

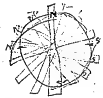

Jan 3 1879

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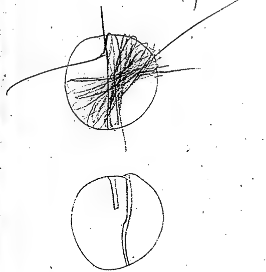
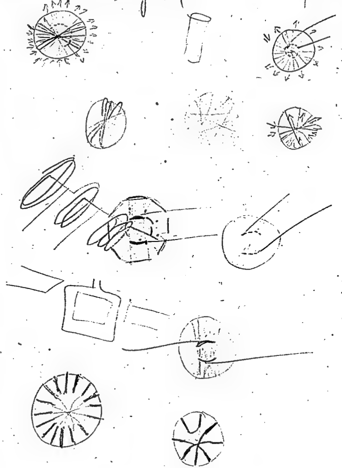


Jan 3 1879 TA



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Jany 3rd 1879

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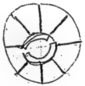
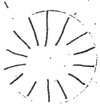
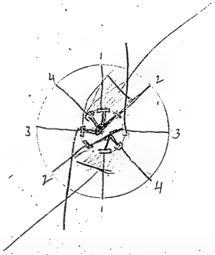
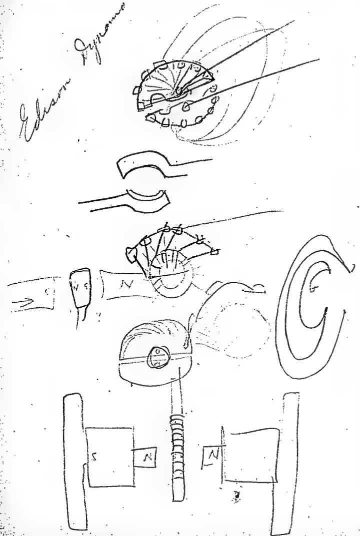
Edison Dynamo







Edison Dynamo



Jany 7 1879

Lamps

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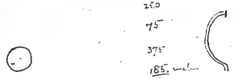

Edison Laboratory Note Book No. 7.

Pages 135 to 137.

Incandescent Lamps!

See Edison Patents:

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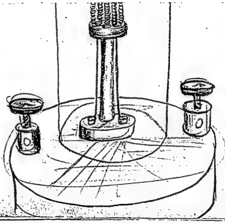

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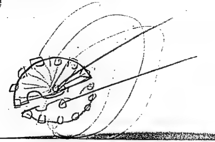
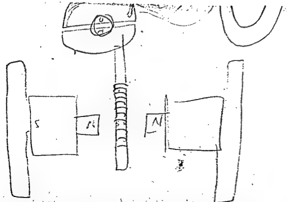
Edison Dynamo





Jany 7 1879 135

Lamps

3/4.

4

2

25.0

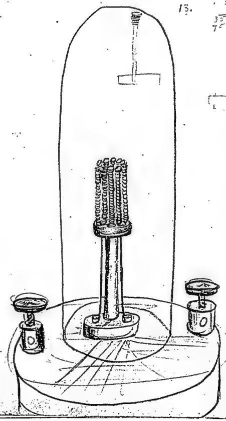
75

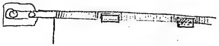
375

185.

13. 350 7 350 750

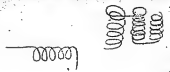
12.



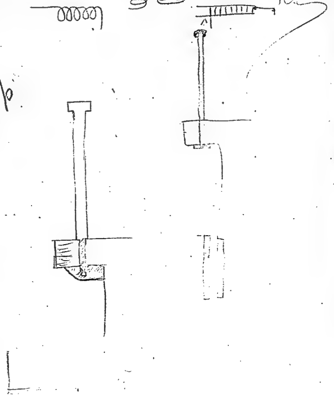


Jany 7 1879

TAE



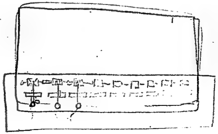
Lamp

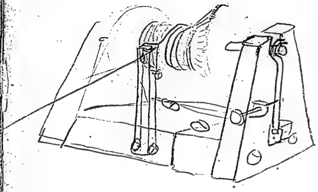


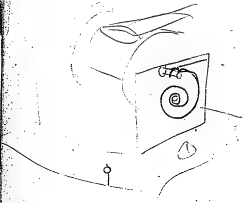
138

Pages 141 to 149. "Theoretical Sketches" (Unimportant)

Aug 7 1879
TAE

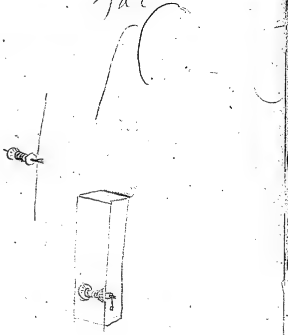


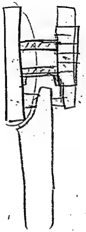




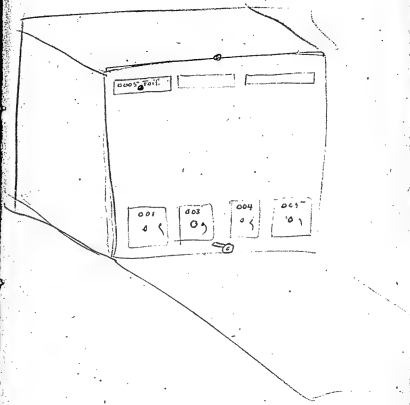
Jany 7 1879

TAE





Jany 9 1879
TAE



8
16
32

4
8
16
32

60 20 40 2 4
120

Tas

.004 = .004

.4 = .004

.125 .004

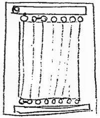
.002 .004

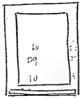
.0022 .004

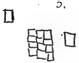
$\frac{17}{200}$ $\frac{9}{100}$ $\frac{1}{4}$ = 1.25 = .004

Resistance

.004

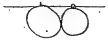






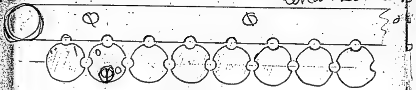
5.

60 50



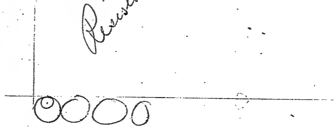
Resistance wires

Jan 9 1879
Chas Batchelor



20 wires = 20 ohms
or in multiple are ·05

Resistance

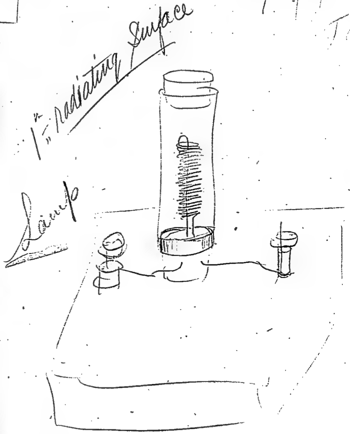


150

Pages 151. "Sketches & Calculations" (Un[illegible])

151

Jany 9 1879
TAE



.36
55
180
180
19.80

.017

.0174
3.14
068
017
051
.05338
.10676
20

.018 | 1000
1000 | .350
56

55) 20.00 (0.36
165
350
330
.12
100

17

.12
.009
.1.1.1

20 inch length
40 " " length

55) 40.00 (0.73
385
150
.018

.73
24

.24
009
.234
100

Jany 9 1879

Wire .017, in long
Spiral
Diameter .12
Number turns 55

TAI

16.
6
96
12.

.23
3.14
92
23
69
.7222

25
314
100
25
75
7850

33
31.4
132
33
99
1.0362

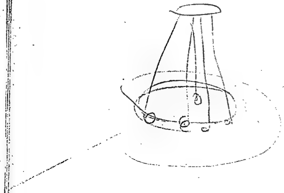
.33
.134
.29.6

50.

72
5
6. 6) 576 (9
.440

54
12
108.
54
648
16
40) 648 (16
40
248
240
41

150



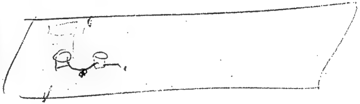
151

Jany 9, 1879
TAE

$$\begin{array}{r} 72 \\ 8 \\ 6\,)\,576\,(96 \\ 54 \\ \hline 36 \end{array}$$

$$\begin{array}{r} 96 \\ 6 \\ \hline 576. \end{array}$$

3



36 : 10
20
36

1 2 : 1 36 2 : 1

10
62
20
60

135

Screw 10 to inch Spindle 18
enter shaft 27

Gears. 20 - 24 - 30 - 32 - 40 - 44 -
48 - 52 - 56 - 60 - 64 - 126

Threads wanted 166
54 40 - 48 — 20 - 60

189 threads 20 - 60
20 - 126

156 = 20 - 60
24 - 126

126 = 20 - 60
30 - 126

Jany 9 1899
TAL

60
20
60
20

126
20
126

20 / 1260
63
126
378
126
6
20 / 7938

30 / 1260
42
60
20 / 2520
126

7 / 1260
63
32
60
20 / 3120
166

30 / 1260
42
60
20 / 2520
126

30 / 1260
63
60
20 / 3780
189

1260
39.36
12 | 2521.0.32
157
166
111
7 | 640
27
2520.32
126
111
34
126
10
27 | 1260 | 34
32
176

Jany 9 1879 TAE

135 threads – 20 – 60 / 20 – 60 wheels

166 = ~~177.21 20 – 60 = 34 – 176~~

$\boxed{157 = 24 - 60 - 32 - 126}$

189 = 20 60 – 32 176.

160 Jany 9 1879 TAE

Question. How can voltaic cells be arranged in multiple arc and what effect will they produce.

Laws. The votaic cell indicates only the current, or as it is called the quantity of Elec. passing through it, It is only another form of galvanometer.

A number may be put in series and each one will give an equal amount of gas no matter what the surface of the platinum or the resistance in any one is. This will be only true when the current has been passing for a time sufficient to saturate all the various platinum electrodes with gas.

The "hindrances" ~~may~~ to the passage of the current are two-fold. First the resistance of the water as a conductor. Secondly the opposing electromotive forces set up ~~on~~ the surfaces of the immersed plates.

The resistance may be measured in two ways, making it first say one inch and measuring the current, then two inches and measuring. The difference will ~~[illegible]~~ be due to the added resistance for the greater part. It can also be measured by the method used by

That is to send

 rapidly reversed currents
through the water and
measure the by an electro-
dynamometre. This method
takes for granted that the
polarization is zero for such
currents.

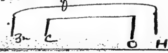
The resistance of the decom-
posing cells will directly be
a dead loss for the current
will be used in heating
it. Indirectly it may
be utilized for the heating of the
water ~~thus making~~ makes
the gas come off more
readily and also warms the
gas and makes its combus-
tion better.

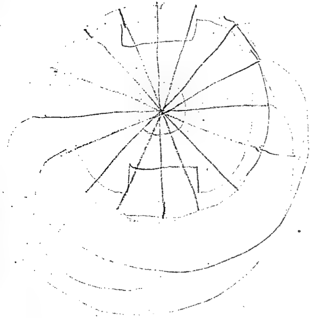
The electromotive force
of a water cell when the
poles are covered with H & O
is about 1.2 Daniells
Sprague gives it at
1.464 Volts a Daniell
being 1.079 1.8 Encycl Brit.

1.464	.165541
1.079	.031004
1.363	.134537

1.363 Daniells

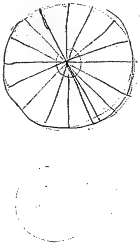
The H is carried with the
current the same as a metal
and thus the O will be
formed at the pole connected
with the + of battery and H
with that of the −





January 9 1879

TAE



164

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January 9th 1879

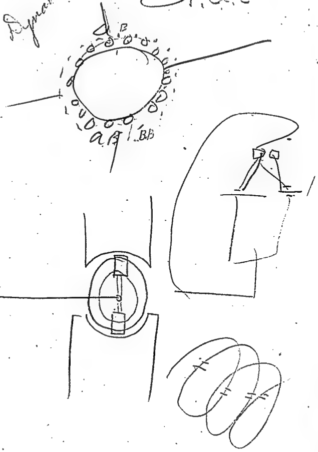
JAE

Pages 169 to 214. "Dynamo Notes" (Unidentified)

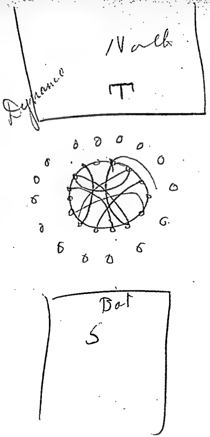
February 16 1879

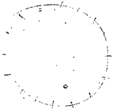
A.a.E

Edison Dynamo

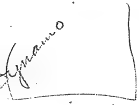


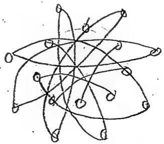
Edison Dynamo

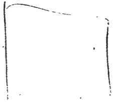




Edison Dynamo





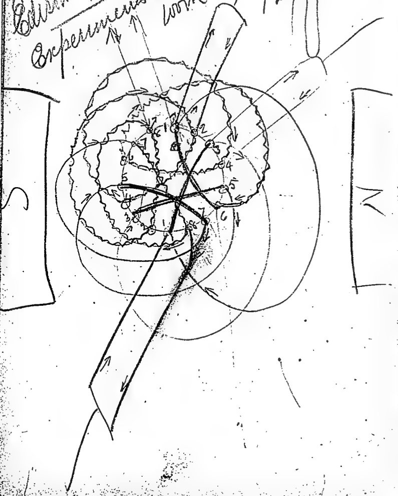


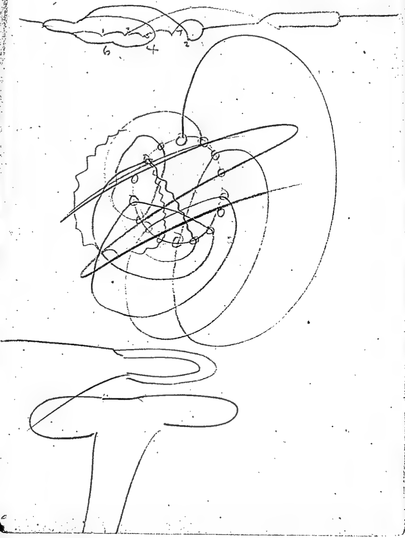
Feb 15 1879

Edisons Magnets

Experiments to make the work

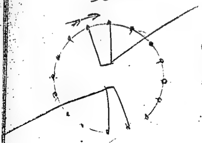
Batchelor





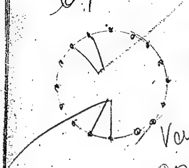
 Exp 1 page 174 Feb 15 1879 Chas Batchelor
Commutator Springs &c

Exp 1



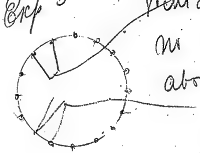
Went all round
no current except
a shock at each
revolution

Exp 2 Bat



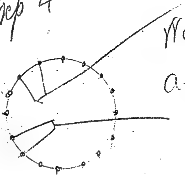
All round
~~no Current at~~
Slight spark,
Very little spark at
Commutators

Exp 3

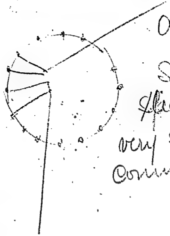


Went all round
no better
about same

Exp 4



Went all round
about same

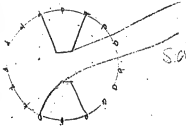


All round

Same

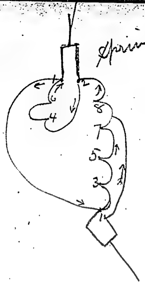
slight spark

very small spark on commutator

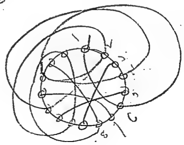


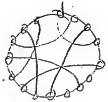
All round

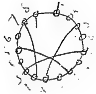
same as before



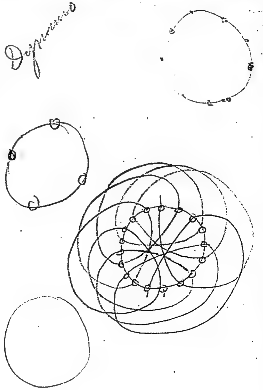
Edison dynamo



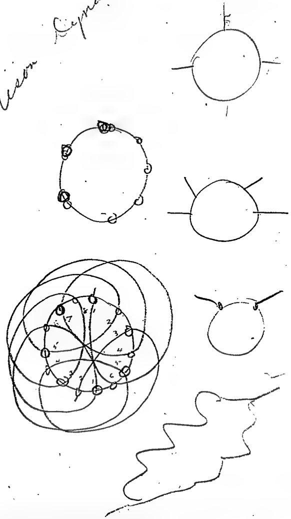




Edison Dynamo

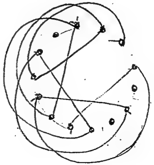


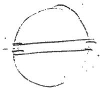
Edison Diagrams

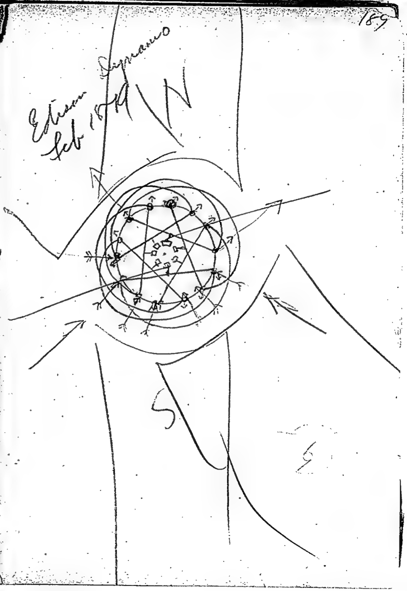


Feb 1879

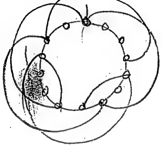
Edison Dynamo

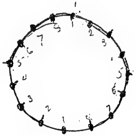


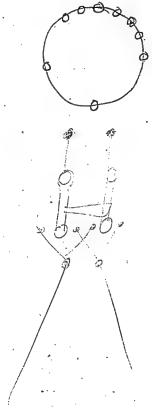


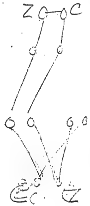

Edison Dynamo
Feb 1879
N
S
S

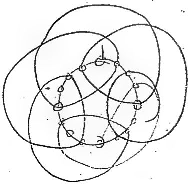
Edison Dynamo

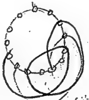


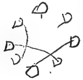




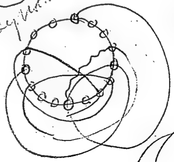

Z
C

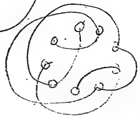


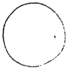




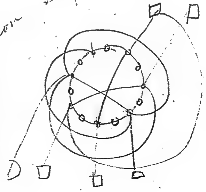
Edison [illegible]



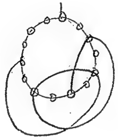




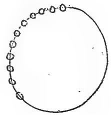
Edison Dynamo

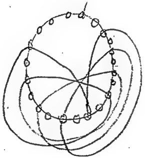


Edison Dynamo

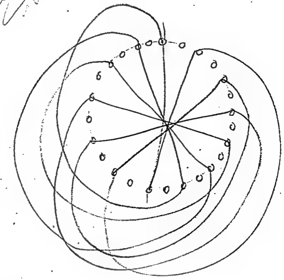


Edison Dynamo.





Edison Dynamo Magneto



13

6

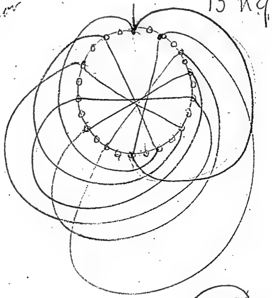
4 3 5.7.

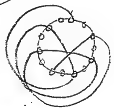
8

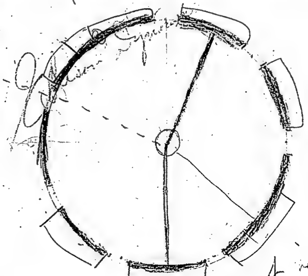
1.2

Edison Experiment

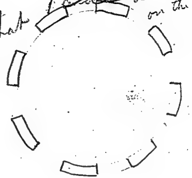
13 nq.







Proof that ~~[illegible]~~ cannot be used on the 8 commutators




Edison Dynamo

36
60
2160

728
3
2184

46
3
138

60 Rev

fly wheel 12 feet

46 inch pulley.

runs 188,1

728
6
4368

728.

188
46
1128
752
8648

12) 8648 (728
84
24
24
8

I find that acetate Lime, magnesia Chloride of lime, Magnesia or Alumina will not coat [illegible] wire by [illegible] [illegible]

Edison Laboratory Note Book No. 7.

Page 215.

See Edison Patents:

214,636	227,227
214,637	227,228
218,866	227,229

Solution of Magnesia acetate [illegible] of same after [illegible] time.

214

46

$$\begin{array}{r} 36. \\ 60 \\ \hline 2160 \end{array}$$

$$\begin{array}{r} 728 \\ 3 \\ \hline 2184 \end{array}$$

4368

46 inch p

runs 188,1

728.

$$\begin{array}{r} 188 \\ 46 \\ \hline 1128 \\ 752 \\ \hline 8648 \end{array}$$

$$12)\,8648(728$$
$$\begin{array}{r} 84 \\ \hline 24 \\ 24 \\ \hline 8 \end{array}$$

Feby 24 1879. 273

I find that acetate Lime, magnesia
Chloride of lime, Magnesia or
Alumina will not coat iron
wire by immersing in liquid
& then heating & repeating
the operation many times
But Platinum is coated
easily - a Beautiful
Coating that very smooth
is put on platina with
immersing it in a Syrupy
Solution of Magnesia
Acetate & holding in
flame a few
times.

Pages [illegible] to 228. "Notes on [illegible] Telephone [illegible] Unimportant.

3 ℥. Chalk (precipitated)
9 grains Acetate Mercury
1/2 fluid ℥. Caustic Soda — 1

3 ℥ Chalk
5 grains Acetate Mercury — 2
1/2 fluid ℥ Caustic Soda

3 ℥ Chalk
No Mercury — 3
1/2 fluid ℥ Na.O.

3 ℥ Chalk
15 grains Acetate — 4
1/2 fluid ℥ Na O

3 ℥ Chalk — 5
25 grs Acetate Mercury
1/2 fluid ℥ Na O.

3 oz Chalk
40 grs Hg acetate
1/2 fluid oz Na.O. 6

3 oz Chalk
100 grs Hg Acet.
1/2 fluid oz Na, O. 7

3 oz Chalk
9 grs Hg Acet.
3/4 fluid oz Na, O. 8

3. oz Chalk
9 grs. Hg Acet.
1 fluid oz Na, O. 9

3 oz Chalk
25 grs Hg Acet.
1 fluid oz Na O 10

3ʒ Chalk
1 ʒ Na O.

~~The Chalk and Acetate Hg to be ground up very finely~~

Mercurous "Acetate" sparingly soluble in water !

Dissolve the Acetate Hg in hot water sufficient to just wet the whole of the Chalk, mix with the chalk. It must be ground thoroughly so that every part of the chalk is wet, afterwards the chalk is laid out to dry without heat, after drying it is put in a mortar and the Caustic Soda poured on it and thoroughly ground and allowed to dry so that it is just damp only to the touch, In this condition it is to be put into a bottle and closed and labeled

March 17/79 J. Lawson

Pulverized the Mercurous Acetate finely in a mortar, sifted, and mixed intimately with the calcium carbonate by placing layer in sieve, then sprinkling thin layer of Mercurous acetate, then layer of Calcium Carbonate, and so on, and sifted the whole. [illegible] 60 sieve.

Repeated the sifting process three times, each time mixing more intimately by means of spatula.

Added con. sol. of

Sodium Hydrate with enough water to make the whole of the consistence of dough, ground thoroughly [volume of sodium hydrate and water 60 c.c.], then set aside to dry.

75. .75

25

6

1.9

.9

1.6

1.1

.57

.51

.6 External

1 Carbon cell

2 Volts .2 internal

40 bars 2 Volts

1.0 internal

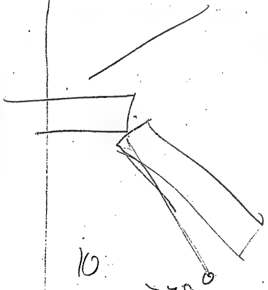
.6

$C = \frac{2.0}{1.6} = \frac{5}{4} = 1.25$

$\frac{25}{16} \cdot 6_3 = \frac{75}{8} = .94$ E

Carbon $\frac{2.0}{.8} = \frac{10}{4} = \frac{5}{2} = 2.5$

$\frac{25}{4} \cdot 6_3 = \frac{7.5}{2} = 3.7$ Energy



10

.772

75°

75
50
3750

1

100)2000
20 per hour

3750
2000
7,500,000

33 ~~00~~)7.500(~~000~~ lbs
66 (~~3~~ 20
90
66
240

60)224
3.73

772 ft lbs
lb H_2O 7

75 saved
5 00 saved
3750 per lb H_2O

2000
60) 7.500,000 ft lb per ton
1

33000 33000
60 60
1980000 1980000

1,980000) 7,500000

198) 750. (3.7
594
1560

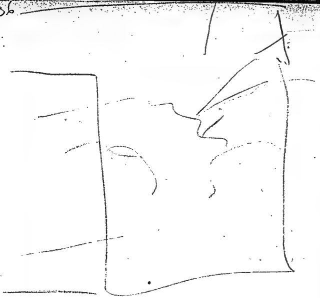
772
100
33000) 77.200 (
66

2 1/3

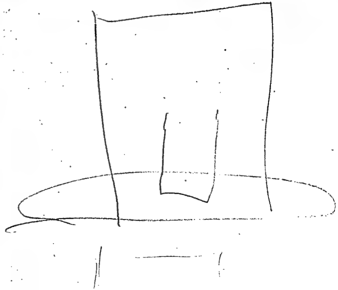
2000
4666

772 33000
2000 60
100
77200
1554 00000
1980000

198) 1554 (7



200



238

Menlo Park
Apr 1879

April 6. 2 a.m.
Leclanché cell on 100 Ohms
45° = D

9 a.m.
15° = D
11. 30 a.m.
130

Open for evaporating

239

3 — 4.0 P.M
25° = D
4 - 5 P. M
15 = D

Taken off
8 — 40 P. M
27° = D
Polarized quickly
~~Taken off after one~~
Put on 100 Ohms
9 - 20 D = 17°
Taken off

10-10 P.M

$23° = D$

~~I have put on alternate [illegible]~~

April 8

9-5 A.M

on all night

$D = 18°$

Taken off

1 Daniells

$4\frac{1}{2} = D$

2 Daniells

$9° = D$

12 M

$D = 27°$

on until

1-35 P.M

$D = 14°$

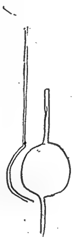
Taken off

put 5-25 P.M

$17° = D$

9 P.M.
$10^{\circ} = D$

Taken off
May 9
$15^{\circ} = D$
Battery drying



Pages 245 to 275." B. L A N K".

1000 -

1 + 1

1 + 1 + 2
2 + 3 + 4

999

Pages 276 to 284. "Lamp & Dynamo Notes, &c." (Unimport

$$C = \frac{e}{R + r}$$

$$= \frac{1}{1+1} = \frac{1}{2}$$

$$C = \frac{\mathcal{E}}{\cancel{R} + r} = \frac{1}{1} = 1$$

$$C' = \frac{\varepsilon}{r} = \frac{2}{2} = 1$$

$10000 = R$

$$\frac{\mathcal{E}}{2}$$

12 inches of $\frac{9}{1000}$ wire,

4 = $\frac{4\frac{1}{2}}{1000}$

$2\frac{1}{2}$

~~8~~

16 —

3/8

8

16 lights

200 3 / 600

3600

20 7 300

1000

66 turns

12000

5 10. ohms. 36,

800

2

32
64,

.23 ohm
5
1.25,

14000

25
10
—
[illegible]

250
.2

16) 200 (12 1/2
16
—
40
32
—
8

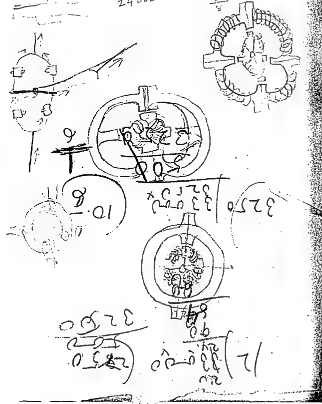
20
10
—
1200.

24
8
—
192,

If this was wound in a flat spiral
scant 3/8 by 1 inch. Each turn has 1 inch of wire,
500 turns without zircon could be put in but
with zircon say 200 turns (ie) 200 inches
now 200 inches would measure cold
say 700 ohms when incandescing it
would measure 3500 ohms —
hence there is no difficulty in making
a lamp having 2 or 3000 ohm resistance
if the wire was $\frac{4}{1000}$ it would have say
800 ohm resistance

Dynamo Mac Dec

3000.	1
6000	1/2
12000	1/4
24000	1/8



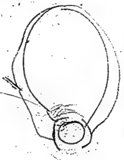
$\frac{2}{1000}$ wire 11 inches
actually measures 40 ohms

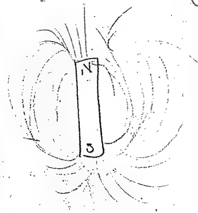
16 inch of 0 9000

or $\frac{9}{1000}$ measures 2 ohms at
temperature of the atmosphere
62, at incandescent point it
would measure 5 times more or
10 ohms — in $\frac{4\frac{1}{2}}{1000}$ it would
have 8 ohms resistance, or 40 ohm
at incandescing point if it were
$\frac{2\frac{1}{4}}{1000}$ it would be 32 ohms, or 160
ohms at incandescing if at $\frac{1\frac{1}{8}}{1000}$
it would 128 ohms or 640 ohms at
incandescing Is this OK —

Then 32 inches 1280 ohms
64 inches 2560
128 5120
256 10240 ohms

Éaim 1.
e é – 5





Menlo Park Notebook #8 [N-78-12-20.2]

This notebook covers the period December 1878-June 1879. Most of the entries are by Francis Upton. There are also entries by Edison, Charles Batchelor, John Kruesi, and George Jackson. All of the material relates to experiments on electric lighting. There are notes and calculations by Upton about meters, a series of tests by Upton on generators, and Upton's calculations for an electric lighting system. Other material includes a test machine for driving magnetos, designed by Batchelor and built by Jackson; notes by Edison on hand turning a generator; and drawings by Krusei showing the layout of pipes in one of the laboratory buildings. The label on the front cover is marked "Faradic machines No. 1" and "Electro deposition Tests." The book contains 284 numbered pages.

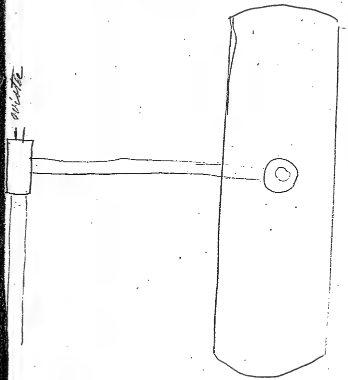
Blank pages not filmed: 76-77.

No 8

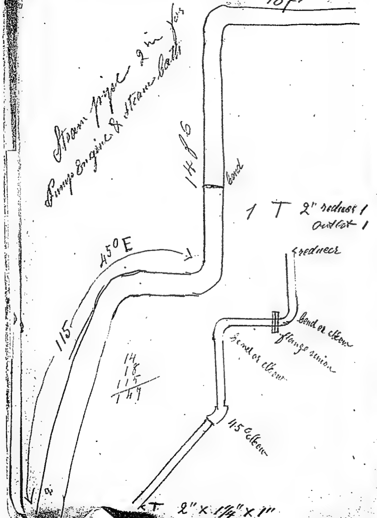
Pa[illegible] I to 1884. notes on batteries, testing instrument. & dynamo tests (Ohm-meter)

On hand 150 ft. 1"

4554
3141
7854
23562
7854
2466156
4
31416



Starting Point from Knowles pumps

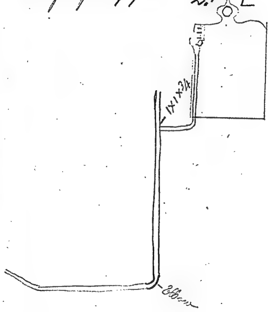


Trip pipe from exhaust & water gauges.

12 f. 3/4 1 3/4 Elbow

1 T 1" x 3/4

58 f. of 1" pipe 2.1" E



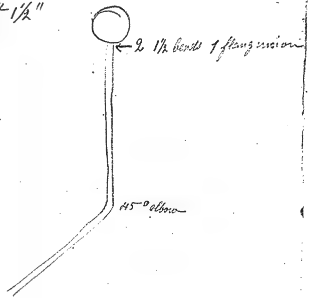
Suply pipe for cistern
all 1½" galvanized

2 1½ bends ex. 2 coupling

2 45° Elbows

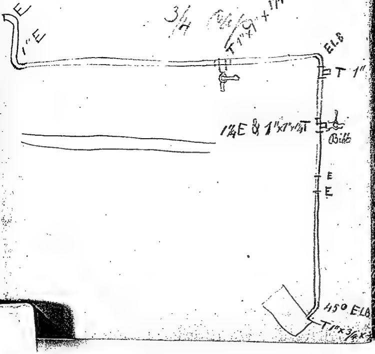
1

100 ft 1½"



Water supply from Gallary to
& through main building

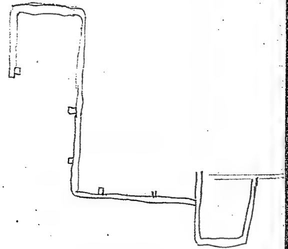
60 1 T. gavanized
122 4 E 2 T
1
1 45° E 1"
4 1" nipples
3/4 [illegible] + 1¼ & 1¼ E

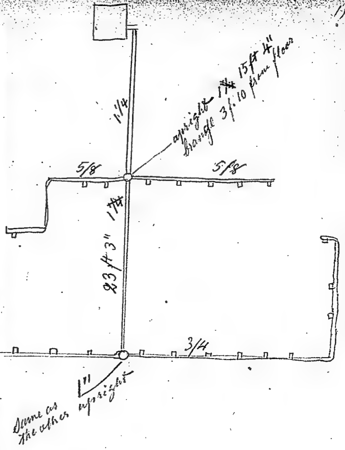


150 ft of 2 inch plain pipeing for steam under boiler pressure for I
100 ft gavanized pipe 1½
45 " " " 1 inch for small sue n. p.
100 ft of 1 in plane pipe
40 " " 1¼ " "

2. 2" Wrought iron bends of steam ✓
2. 2" flange unions ✓.
2. 2" shoulder nipples.
1. 2" Globe valve for steam
1. T 2" = 2" × 1" " "
1. bushing ~~from 2" to 1¼~~ to reduce from 2" to 1¼
1. T 1" = 1" × 3/4
3. 1" Elbows
4. 1" nipples shoulder
4. 3/4 "
2. 1½" wrought iron Bends ✓ 4 extra 1½ cupplings
1. 1½ nipples shoulder
1½ elbows gavn. 45°
1½ elbow
1½ flange union
1" 45° elbow
bushings to reduce from 1 to 3/4
reducer from 1 to 3/4

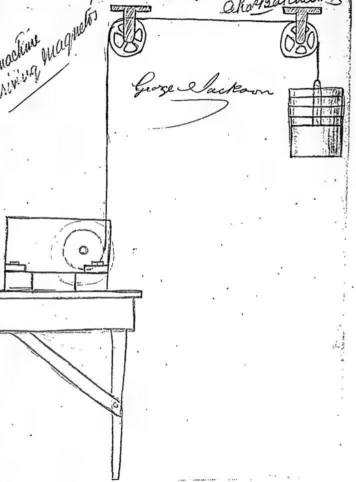
2. reducer from 3 to ½
10. 1" Elbows
3. 3/4 wrought iron bends
1. 1½ plug
2 1" "
4 extra 1" cuppling
4 " 3/4 cuppling




1 1/4
upright ~~1¼~~ 15ft 4"
branch 3f. 10 from floor
5/8
5/8
1¼
23ft 3"
3/4
1"
Same as the other upright

Dec 20 1898
Chas Batchelor

Test machine
for driving magnetos



George Jackson

Diameter of inside of cylinder.
5·0625 inch

Length of Vulcanized fibre 16·29 inch
overlap about $1\frac{5}{16}$ inch

Bend first round cylinder of smaller diameter so as to have the overlap at control & rivet it up so ~~that~~ it will not quite go on the finishing cylinder then heat & put on ~~the~~ finishing cylinder & let cool

a Daniells cell over one Siemens will decompose in one second .108 Mllgr H_2O

.108 Mllgr

E.M.F. Daniells 1.17
Resis Siemens .9730
1.0493

log .108 $\bar{1}.0334$
comp log 1.17 9.9318 — 10
log f 1.0493 0.0210
$\bar{2}.9862$

.0969 Mllgr 1 Volt
over 1 Ohm of H_2O

1 Weber

1 Farad one second

.0969 Mllgr

The determination of Weber show that ~~re~~ a current having the intensity of one decomposes in one second .009376 Mgr. H_2O

or .000009376 Grammes

D 11.6

.00092 Grammes

.00092 Grammes

~~.00092~~ Mllgr

.92 Mllgr

.092 Mllgr $\frac{1}{10}$ Daniells

Calculated for Wied.
pp 428-29.

.096 Mllgr

~~A Daniells cell~~

The chemical unit of E.M.F. is a force sufficient over one Siemens to decompose 1 Mllgr of H_2O

E.M.F in ch. units of a Daniells

log .01204 $\bar{2}$.0808
= $\frac{1}{830}$ 2.9192

A current which decomposes a Mllgr of H_2O in one second has an absolute (Weber's unit) 950.

There is given off

101.92^{10^3} metre grammes of heat in one second by one Weber of current over one Ohm Latimer Clark, p. 10

.00336 Grammes of Zn burned

by giving off this current, Zn burned in a Daniells cell which gives in this combination 714 gm deg C per gramme

.00336	$\bar{3}$.5263
714	2.8537
425	2.6284
Comp log 1.17	9.9318 − 10
	2.9402

872.

log 1019. 3.0084

$101.92\,10^3$ Metre grammes Work

$10192\,10^3$ Centi grammes

$101.92 \times 10^3 = 1.0192 \times 10^4$

4156×10^4	7.6186
714	2.8537
.00336	$\bar{3}$.5263
	~~7.9800~~
	7.9986

42500 4.6284
981 2.9917
7.6101.

4175/10^4

.00341
714
L

In the E. B ~~Vol. VII~~ p. 105 is given a table stating ~~of~~ the amount deposited of the various elements ~~compounds~~ by a unit of current, one Weber in one second. The table is based on the assumption ~~so called~~ ~~fact~~ that the amount of H_2O decomposed by one C.G.S. ~~M~~ electro magnetic unit of ~~current~~ electricity, is .00093 gramme ~~under authority of~~ quoting as authority Weber, Joule, Bunsen, Casselman, and Kohlrausch and citing Wied. Galv. Bd. III §§ 1077-1079

The value of Cu. on the authority of Faraday, for the equivalent, is given as ~~.00326~~ .00326. A unit of current is ~~about~~ slightly less than that given by a Daniells cell on a circuit of one Ohm. ~~There-fore it~~ It is thus very easy to obtain a proof of ~~the numbers~~ the numbers in the table, For example Wiedemann states on the authority of Raoult that a Daniell cell on a circuit of one Siemens deposits 0.377 Millgr ~~that is~~ ~~one of . . 0.0003~~ That is ~~of~~ Daniells having an E.M.=

The Volt being $\frac{1}{X}$ Daniell
The current being x Ohm

	0.377	$\bar{1}.5763$
comp	1.11	9.9431 −10
comp	1.049	9.9881 −10
		$\bar{1}.5075$ −10

.321 Millegr
.000321 Grammes

of 1.14 Volts and
a Siemens being 0.973 Ohms
the amount deposited by a Weber
in one second is

$$\frac{0.377 \times .973}{1.14 \times .001} = \cancel{.340 \text{ Millig}} = .00034 \text{ Grammes}$$

$\bar{1}.5763$
9.9431 −10
10.0119 −10
$\bar{1}.5313$

which is about one tenth of the quantity in the Table.
~~In referring to~~ Wiedemann
gives in the reference cited
by the Encycl. Brit. §
Bd II § 1077

that a Weber's unit of current, that is the current ~~over~~ in a circuit of 1 ~~Ohm~~ $10^{10} \frac{Mm}{Sec}$ ~~[illegible] of [illegible] having~~ containing an E.M.F of ~~[illegible]~~ $10^{10} \frac{Mm^{\frac{3}{2}} Mgr^{\frac{1}{2}}}{Sec^2}$, will decompose in one second .00933 Mllgr.

1 Volt is $10^{11} \frac{Mm^{\frac{3}{2}} Mgr^{\frac{1}{2}}}{Sec^2}$ or ten times ~~as~~ greater than ~~a~~ Weber's unit, so that it would ~~deposit~~ decompose .0933 Mllgr in one second, or .0000933 ~~Mllg~~ Grammes, again one tenth of the amount given in the Encycl. Brit.

Kohlrausch ~~of~~ gives as the amount of Cu deposited in one

second by a Weber's unit of current as

$$\frac{1.991}{60} = .0332 \text{ Millgr.}$$

~~Wh~~ or by one Weber ~~unit~~ .332 Millg

.000332 Grammes one tenth of the ~~K~~value given.

~~B~~ Some results as to the E. M. F. of a Daniells are deduced in the Encycl. Brit. seemingly on the authority of Sir William Thompson pp. 84-85.

From the equation $E = Je\,\Theta$

$J = 4156 \times 10^4 \; C \; G \; Sec$

$e = .003411$ for Zinc on the authority of Kohlrausch

$\Theta = 734$ (grm. deg. C.)

The result ~~1.5×10^4~~

$$4156 \times 10^4 \times .003411 \times 734 = 1.042 \times 10^8$$

from ~~Q~~ which is deduced that the E. M. F. of a Daniells is 1.042. C. G. S.

1.042×10^8 expresses the amount of heat in absolute measure ~~from~~ given off ~~by~~ from one Ohm when the total circuit is, if 1.042 expresses the E. M. F. of a Daniells 1.042 Ohms.

1 ~~Volt~~ Weber should give off on one Ohm according to this reckoning 10^8 $\frac{C.G.S.}{Sec}$ units of heat in one second. In Clark and Sabines Elec Tables and Formulae this ~~Latimer Clark~~ gives ~~the~~ amount of ~~work~~ is given as $10^3 \frac{g\,m^2}{Sec^2}$ or $10^7 \frac{g\,c^2}{Sec^2}$ which is again 1/10 of the figures in the article.

3

The error is of course repeated several times. Jenkin in his book on electricity and magnetism makes the same error and gives a table which seems to bear very little relation to the ~~equivalents~~ ~~of~~ Electricaltypical equivalents of ~~Heat may be seen on~~ ~~re-stated~~

Yours Truly
Francis R. Upton
Menlo Park N.J.
Apr. 1879.

1/2 Ohm magnet

To give an idea of the efficiancy of a Thermo as against a Calland working on 1/2 ohm resistance.

Given a thermo say of 20 elements equal in E.M.F. to one Calland cell.

If Resistance Calland = 2 Ohm
" " Thermo = 2 "

Then $C = \frac{e}{R+r} = \frac{1}{\frac{1}{2}+2} = \frac{2}{5}$ in each

If Resistance Thermo = 1 Ohm

Then $C = \frac{1}{\frac{1}{2}+1} = \frac{2}{3}$ $\frac{2}{3} \times \frac{5}{2} = \frac{5}{3}$

$1\frac{2}{3}$ times more current than from Calland.

If Resistance Thermo = $\frac{1}{2}$ Ohm

$C = \frac{1}{1} = 1$

$2\frac{1}{2}$ times more effective

If Resistance Thermo = $\frac{1}{4}$ Ohm

$C = \frac{1}{\frac{1}{2}+\frac{1}{4}} = \frac{4}{3}$ $\quad \frac{\cancel{4}^{2}}{3} \times \frac{5}{\cancel{2}} =$

$3\frac{1}{3}$ times more effective.

If Resistance Thermo = $\frac{1}{8}$ Ohm

$C = \frac{1}{\frac{5}{8}} = \frac{8}{5}$ $\quad \frac{\cancel{8}^{4}}{\cancel{5}} \times \frac{\cancel{5}}{\cancel{2}}$

4 times more effective.

If Resistance Thermo = 0

$C = 2 \quad 2 \times \frac{5}{2} = 5$

5 time more effective

$$\mathcal{E} = \frac{\varepsilon}{R}$$

$$W = \frac{\varepsilon^2}{R} = C\,\varepsilon$$

$$\frac{\text{Mllgr}^{\frac{3}{2}}\ \text{Mm}^{\frac{1}{2}}\ \cancel{\text{Mllgr}^{\frac{1}{2}}}\ \text{Mm}^{\frac{1}{2}}}{\text{Sec}^2}$$

$$\frac{\text{Mllgr}^2\ \text{Mm}}{\text{Sec}^2} = \text{Agr W}$$

Olshufs

$R = 10^7$ $\quad 10^4$

$= 10^{12}$ $\quad 10^7$

$= 10^{11}$ $\quad 10^{12}$

.03411

714

4155

10^6

Mllgr

$\frac{\text{Mllgr. Mho.}}{\text{Sec}}$

$10,12 \times 10^{10}$

$1,012 \times 10^{11}$

4156	3:6185	$\frac{\text{Gr C}}{\text{Sec}}$
10^4	4.	
734	$\bar{2}$.8657	
.00341	$\bar{3}$.5328	Grammes
	8.0170	

.00341

.0341

$\mathfrak{A} = \mathfrak{I}\mathcal{E}$

~~$\mathfrak{M}$~~ $\left(\mathcal{L}^{\frac{1}{2}}\mathfrak{M}^{\frac{1}{2}}\right)\Big($

$\left(\mathcal{L}^{\frac{1}{2}}\mathfrak{M}^{\frac{1}{2}}\right)\left(\dfrac{\mathcal{L}^{\frac{3}{2}}\mathfrak{M}^{\frac{1}{2}}}{\mathcal{T}^2}\right)$

$\mathfrak{A} = a\,\mathfrak{z}\,\mathfrak{I}\,w$

$\mathfrak{I}$, here is a number

~~one~~ aw expresses the ~~...~~ heat evolved ~~warmth~~ by burning one ~~equiv~~ unit of Zn

$\mathfrak{z}\mathfrak{I}$ expresses ~~one~~ the equivalent consumed

a Joules equivalent

$\mathfrak{z}\,\mathfrak{I}$ $\mathfrak{z}$ is the amount of Zn decomposed by a unit of current

$\mathfrak{I}$ is the number of units of current passing

$\mathfrak{I}$ is simply a numeral

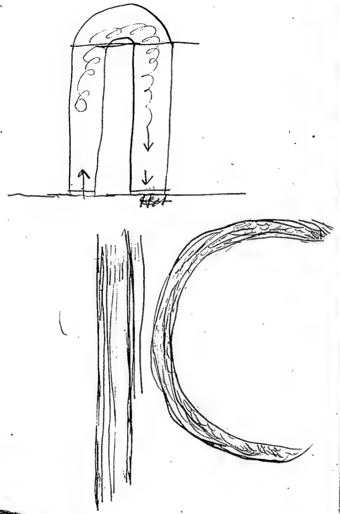
$\mathfrak{I}\mathcal{E} = a\,\mathfrak{z}\,\mathfrak{I}\,w$

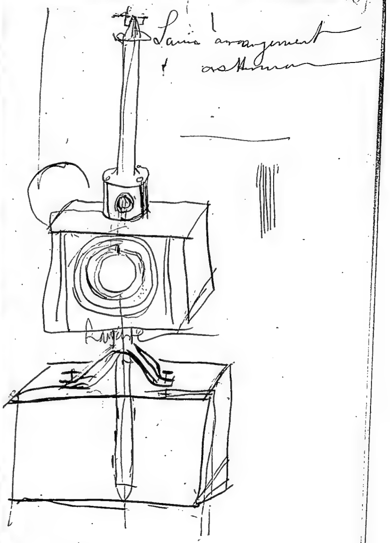
this equation is not wholly true

$\mathfrak{I}\mathcal{E} = a\,\mathfrak{z}\,i\,w$

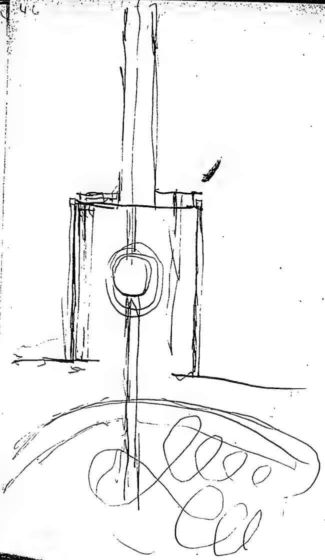
i a numeral

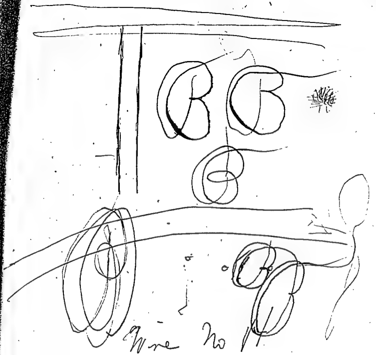
$\mathfrak{I}\mathcal{E} = a\,\mathfrak{z}\,i\,w$





Same arrangement
of antenna

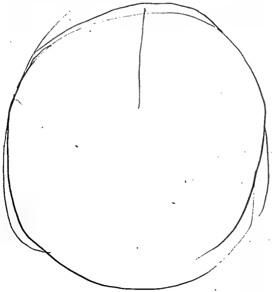




Wire No 11

Draw the Aluminum

wire to [illegible]



10

31,415

31,415 Centim

31,415	1.4970
18.	1.2553
	2.7523

5.65 Metres

5.65	0.7523
.0375	$\bar{2}$.5740
	$\bar{1}$.3263

.212 Ohms

$\frac{1 \text{ foot}}{50}$

17.72
886. Ohms

1500
40

$\frac{40}{1000}$

$\frac{1}{25}$

$\frac{1}{25} = \frac{x}{64}$

$\frac{64}{25} = x$

25) 64 (2.5
50
140

$\frac{2}{64}$

Buff paragraph II. 1059. W. G.
Daniells
"liberates in one second through
1 Siemens
.0116 Mllgr. H

Raoult II 1060 W. G.

Daniells 1 Siemens 1 second
.377 Mllgr Cu.
.108 Mllgr water
.012 Mllgr H

1074 II W G
1 Ohm = 1.0493 Siemens

Kohlrausch II 1080

1 second unit of current
.11363 Mllgr Ag
.009476 Water

~~From~~ Casselman, Bunsen ~~of~~
and Weber, using tan galva and
measuring horizontal intensity
of the Earths magnetism of
at the same ~~time~~

.009421 Mllgr Water
Electro chemical equivalent of
water

E. M. F of Daniells
= 11.57
11.08 E. M. F. Kohlrausch
10.25 Bosscha

54

55

1000

10 | 10

1000

10

$\sqrt{10}$ $10\sqrt{10}$

$1000\sqrt{10}$

$\sqrt{10}$ $10\sqrt{10}$ 10000

$\sqrt{10}$ $1000\sqrt{10}$

$1000\sqrt{10}$

$$\frac{\begin{array}{r}10\sqrt{10}\\1000\sqrt{10}\end{array}}{100,000}$$

1000,000

$10\sqrt{10}$
$10\sqrt{10}$
1000

$$\frac{L^{\frac{3}{2}} \cdot M^{\frac{1}{2}}}{T^2}$$

1000 mm = m

$(10\sqrt{10})^3 = 1000\sqrt{10}$

$10\sqrt{10} = 10\sqrt{10}$

$10^6 \times 10^5 = 10^{11}$ 1,000,000

$(10\sqrt{10})^{-3} = \frac{\sqrt{10}}{\cancel{1000\sqrt{10}}}$

$= 10\sqrt{10}$

Cm

$$\frac{\sqrt{10}}{10\sqrt{10}}$$

10

$$1 \quad \frac{10\sqrt{10}}{1000 \quad 10^3}$$

$100\sqrt{10}$

$10^8 \times 10^3 = 10^{11}$

$$1 \quad \frac{Cm^{\frac{3}{2}}\ Gr^{\frac{1}{2}}}{Sec^2} = 1000\ \frac{Mm^{\frac{3}{2}}\ mg^{\frac{1}{2}}}{Sec^2}$$

$Cm = 10$ mm

$Cm^{\frac{3}{2}} = 10\sqrt{10}\ mm^{\frac{3}{2}}$

$Gr^{\frac{1}{2}} = 10\sqrt{10}\ mg^{\frac{1}{2}}$

B. E.

$J = 4156 \times 10^4 \frac{Gr\ Cm^2}{Sec^2}$

$J = 4156 \times 10^9 \frac{Mg\ Mm^2}{Sec^2}$

1000

1000
10^3

W. G

$J = 4156 \times 10^6 \frac{Mg\ mm^2}{Sec^2}$

.03411 Mlgr ~~Gramme~~

.00003411 ~~Mlg~~ Gramme

.0003411

Weber .03411 Mlg

3.411 Gramm

.03411 Mllgr

.00003411 Gramme

.0003411 since Webers unit
= 1/10 Volt

Volt deposits when on resistance of 1 ohm
.0003411 Gramme Gr
or uses it in battery

Mm Mm Mm

$\frac{m^{\frac{1}{2}}\ \ell}{J^2}\ \frac{\ell}{J}\ J$

Mg mm.

$\frac{m^{\frac{1}{2}} L^{\frac{3}{2}}}{J^3}$

$\frac{m \ell^2}{J^2}$

$m^{\frac{1}{2}} L^{\frac{1}{2}}$

61

$\cdot\, m^{\frac{1}{2}} \, l^{\frac{1}{2}}$

$$E.M. \mp f \; \frac{m^{\frac{1}{2}} \, l^{\frac{3}{2}}}{T^2}$$

$\mathcal{L}$ $10\sqrt{10}$

$\sqrt{10}$

100

10^6

10^4 6

.00341 Gramme

00 3.41 Mlgr

.3

.003411 Mlgr

3

.341

.03411 Mllgr

1.000

C G S

$$W = (10^{-1})^2 (10^9) = 10^7$$

$$\left(10^{-1}\frac{L^{\frac{1}{2}} m^{\frac{1}{2}}}{T}\right)^2 \left(10^9 \frac{L}{T}\right)$$

$$= 10^7 \frac{L^{\frac{3}{2}} m^{\frac{1}{2}}}{T^2} = 10^7 \frac{C^{\frac{3}{2}} Gm^{\frac{1}{2}}}{Sec^2}$$

$10^7 \frac{C^{\frac{3}{2}} G^{\frac{1}{2}}}{Sec^2}$ = amount of heat given off in one second by one Weber in one Ohm

---

10^7

1 Daniells cell deposits

Prof. Raoult

.377 Mllgr of Cu

in one second when the total resistance of the circuit is one Siemens unit

---

Daniells has E.M.F. = 1.07 Volts

Latimer Clark

Siemens unit = .973 Ohms

	.377	$\bar{1}$.5763
	.973	$\bar{1}$.9881
Comp	1.07	9.9706 − 10
		9.5350 − 10

.343 Mllgr. in one second by 1 Volt in 1 Ohm

.000343 Gramme

6 $D = 1.07$ Volts

$\bar{1}.9881$
9.9706

$9.9587-10$ constant for change from

Water $.108$ $\bar{1}.0334$ Daniells over Siems

$\bar{1}.9921$ to Volt over Ohm

$.0982$ Mllgr Water per second 1 Volt over 1 Ohm

~~9.0099~~

$.012$ Mllgr H in one second from one Daniells

$.00947$ Mllgr Water decomposed by Weber's unit of current.

$$E = 10^{10} \frac{Mm^{\frac{3}{2}} Mllgr^{\frac{1}{2}}}{Sec^2}$$

This shows that a Weber's unit of E.M.F. is 1/10 of a Volt

$.0120$, Mllgr ~~H~~

$$\frac{.012}{1.0493 \times 10^{-10}} \times 957$$

$$\frac{.012 \times 957}{1.0493 \times 10^{10}}$$

$1 \text{ Ohm} = 1.0493$ Siemens

$10^{10} = 1.0493$ Siemens

$$\text{Siemens} = \frac{1.0493 \quad 10^{10}}{1.0493}$$

4 Ohms outside

1 Ohm inside

4 lamps each of one Ohm how many Ohms can be put in one lamp?

$W = \frac{C^2 R}{\cancel{Q}}$ $\frac{1}{4}$ on each lamp

$E = \cancel{\frac{C}{R} = C^2 R}$ $\frac{C}{R}$

$\cancel{W = EC}$

$W = \frac{E}{R} = \frac{E}{R}$

16 $\frac{E}{R} = 1$ 4

16 $\frac{E}{R} = 1$

$\underline{16}$ $\frac{1}{4}$ Current

$\frac{4}{16}$ $\frac{1}{\cancel{4}}$

1 Ohm in machine

$W = c^2(R+r)$

$= c^2(4+1)$ $\qquad \mathcal{E}=1$

in each lamp

$W = \frac{c^2(4+1)}{5} = \frac{\mathcal{E}}{R}$

$C = \frac{\mathcal{E}}{(R+r)} = \frac{1}{25}$

$W = \frac{1}{25}$

$W = \frac{1}{5}$ $\qquad W = \frac{c^2(4+1)}{5}$

$W = c^2 = \frac{1}{25}$

$C = \frac{\mathcal{E}}{R}$

$W = \frac{\mathcal{E}^2}{R^2} = \frac{1}{25}$

$W = \frac{1}{25}$ on each lamp

$C = \frac{\mathcal{E}}{(R+r)}$

$W = \frac{1}{25}$

$\frac{1}{25} = \frac{\left(\frac{1}{\cancel{2R}+R+1}\right)\frac{R}{R+1}}{\cancel{2R}}$

$= \frac{R}{(R+1)^2}$

$R^2+2R+1 = 25R$

$R^2-23R = -1$

$R^2-23R+\left(\frac{23}{2}\right)^2 = \left(\frac{23}{2}\right)^2-1$

$R-\frac{23}{2} = \sqrt{\left(\frac{23}{2}\right)^2-1}$

$R = \frac{23}{2} \pm \sqrt{\left(\frac{23}{2}\right)^2-1}$

$R = 15.$ Ohms

$2\,)\,23$

11.5

$\sqrt{10.5}$

$= 3?$

11.5

3.6

15.1

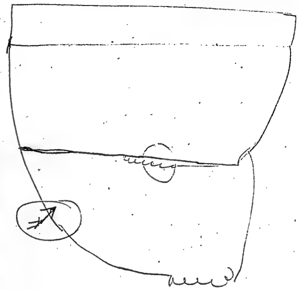
$$\text{Work} = \frac{m L}{T^2} \frac{L}{T} T$$

$$= \frac{m L^2}{T^2} \quad \text{Weber over Ohm}$$

$$= 10^7 \frac{\text{cm}^2 \text{ gramm}}{\text{sec}^2}$$

10^4

.001019



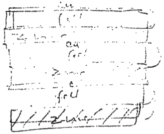
18 Ohms by the method of halfing the resistance

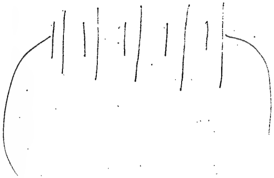
18 Ohms outside

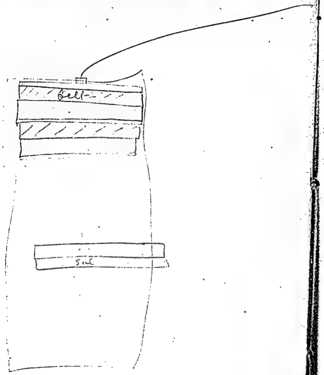
360 ~~Ω~~ = D

0 Ohms outside

185 = D






Bell
Sol

Determination of ~~Gramme~~
Machine running 1060 Revolutions per minute

Galvanometer

A cell composed of Zn amalgamated, neutral solution of sulphate of Zn., porous cup, neutral solution of Cu, electrotype Cu.

This is the standard ~~[illegible]~~ given by Wiedemann and its E. M. F. is about 1.09 Volts

Three ~~[illegible]~~ cells of Gravity are compared and the total deflection obtained from the four.

The galvanometer is then shunted to bring the ~~resultant~~ deflection from the four at about 50 on the scale

Then the E. M. F. from the Gramme is taken over a measured resistance. Measured when hot, From this the Current is calculated and compared with the deflection on the dynamometer.

The constant of the Dynamometer can then be calculated. It is the deflection for 1 Weber.

The square root of the sine of this is the unit division, to divide ~~[illegible]~~ the square root ~~[illegible]~~ of the sine of any other deflection by to obtain the number of Webers.

 The galvanometer

standard cell	200 L
No. 1	180 L
No. 2	180 L
No. 3	180 L

Total brought down to 50

60 = 4 in circuit

Fiducial 1' L

12° 10' = Dynam

22 ~~D~~ = D

over 1.1 Ohms

5 Ohms in total circuit

$\frac{220}{50} = 4.4$

3 Gravity = 2.7 Standard

2.7 + 1. = 3.7 Standard

3.7 X 1.09 Volts 50 Ω

$\frac{3.7 \times 1.09 \times \cancel{220}^{4.4}}{\cancel{50}} =$ Volts

0.5682
0.0374
0.6435
1.2491 17.7 Volts

Com over 1.1 Ohm

17.7	1.2491
1.1	0.0414
	1.2077

16.1 Webers

CR = E

16.1 X 5 = Volts in all
80.5 = Volts in all

Foot lbs

16.1	1.2077
16.1	1.2077
5.	0.6990
44.	1.6435
	4.7579

57.200 ft lbs of Elec.

Dynamometer

12° 10' 2 9.3237 − 10

Webers 16.1 9.4818 − 10

1.2068

Constant $\bar{2}$.4550 .0285

Book 17 p. 144 $\bar{2}$.4249 .0266

This is too large an error ∴
must go over the readings more
times

1.5441
1.8751
3.4192

2620

75
32.5

Again

Standard 200
No. 1 179
No 2 181
No 3 150 say

3.7 Daniell · 50 = D to left
3.7 × 1.09 volts

50/30.7 = 6.14

0,5682
0,0374
6.14 .7882
1.3938
.0719
1.3219

24.7 Volts
1.18
21.1 Webers over circuit

No current 75 D to L

D = 307 1.18 Ohms

Dy 21° 19' see p. 86

Total 3.8 Ohms

21.1 1.3219
3.8 .5798
79.8 Volts 1.9017

(9.5605
4.7802 − 5
21.1 1.3219
3.4583 − 5
$\bar{2}$.4583 Constant dynamo

$\frac{75}{50} = 1.5$

3.7 0,5682
1.09 0,0374
1.5 0,1761
.7817 6.05 Volts
E.M.F. when circuit opened

305 Again — 1060 revs

3.95 Ohms total

19° 56'

R = 1.19 ohms

3.95 Ohms total

19° 56' $\bar{2}$.93323 − 10

4.7661 − 5

3.95 1.3219 .5966 1.9185 21.1 1.3219

3.4442 − 5

829 Volts Constants

$\bar{2}$.4442 21.1 Webers

$\bar{2}$.4550 16.1

$\bar{2}$.4583 21.1 Webers

$\bar{2}$.4249

I take $\bar{2}$.4500

This being safe and probably near the truth.

Gramme 1060 revs.

Again 6.7 Ohms total

89

8° 13'

total. 67 Ohm

8° 13' 9.1550

Probably

$\bar{2}$.4500

6.1275 − 5

13.4 Weber 1.1275

6.7 Ohms .8261

1.9536

89.8 Volts

Probably too much

90 The same

8° 29'

6.1 Ohms total ✓

8° 29 . 9.1658
4.5843 - 5
$\bar{2}$.4500
6.1343
1.1343 13.6 Webers
6.1 .7853
1.9196
83.1 Volts

6° 4'
8
[illegible]

New Machine ω = 85 no [illegible]

10° 18' + 2'
8 Ohms Total

10° 20' 9.2537 -
4.6268
$\bar{2}$.4500
15.0 Webers 1.1768
8 .9031
1.0799

120 Volts

12° 12'

6.34 Ohms

(9.3267
4.6633
6.34 2.4500
1.1133   12.9
6.34 .8021
1.9154   82.3

15 weber   1.1768
1.1768
.9031
1.6435
4.9062

79000
6.6
13

2 1/3 H.P.   8 Ohms in circuit

1.1' 30'

50 Ohms in
25 Ohms short
15 Ohms "
12 Ohms —
10 "
7 "
5 "

9

4 Daniell D = 50

About 50 Ohms in circuit

D = 10

$\frac{10}{50}$ $\frac{4}{5}$ × 1.09 Volts

4.	0.6021
.218	1.3385
	1.9406
	.2041
	1.7365
50	1.6990
	1.4355

on 1.6 Ohms

.545 Webers

27.2 Volts in circuit

After bringing up magnet

D = 20. 544 Volts

Circuit open 105 = D

$\frac{105}{50}$ = 2.1
4
8.4 .9243
1.09 .0374
.9617

9.75 Volts

93

About 30. Ohms in circuit before bringing up magnet

26

on 1.6 Ohms

after 41 = D

on 1.6 Ohms

$\frac{26}{50}$ = .52

.52	1.7160
4.	0.6021
1.09	0.0374
	.3555
1.6	.2041
1.41 Webers	.1514
	1.4771
	1.6285

42.6 Volts on circuit

$\frac{1}{50}$ = .02

.02	2.3010
4.	.6021
1.09	.0374
	2.9405 Constant
41	1.6128
	0.5533
	.2041
	.3492
	1.4771
	1.8263

67.1 Volts on circuit.

~~About~~ 20.5 Ohms Total

on 1.6

Fiducial 5' to right
42
47'

The 10 Ohm spool well warm

75	$\bar{2}$.9405
	.8808
	.8212 6.63 volts
	20.4
	.6172 4.14 Webers
20.5	1.3118
	1.9290 84.9 Volts
47'	8.1358
	4.0679
	.6172
	3.4507
	$\bar{2}$.4507 Constant

11.2 Ohms total

195 on 1.63 Ohms

4° 24' + 4 4° 28'

Current sufficient to jump across the plug

	$\bar{2}$.9405
195	2.2900
	1.2305
163	.2122
	1.0183 10.4 Webers
11.2	1.0493
	2.0675 116 Volts in circuit
	8.8914
	4.4457 -5
	1.0183
	3.4274
	$\bar{2}$.4274

10.2 Ohms Total

$D = 225$ ... 1.67 Ohms

$5^\circ\ 50'$

$\bar{2}.9405$
2.3522

1.2927 19.6 Volts
0.2227

11 1.0500 11.2 Webers
10.2 1.0086
2.0586 Volts

114 Volts

$9.0070 - 10$
$4.5035 - 15$
1.0500
$3\ 4535$
$\bar{5}.4535$ constant

7.25 Ohms Total

$10^\circ\ 30'$

9.2626
4.6313 -5
$\bar{2}.4500$

7.25 1.1813 15.1 Webers
$.8603$
2.0416 111 Volts

~~Ohms 7 Total~~

Gramme - 1040 rev

6.74 Ohms Total

5° 40'

2(8.9945

4.4972

2 4500

11.1 Webers 1.0472

674 .8287

75.9 Volts 1.8759

8° 43'

5.77 Ohms Total

9.1805

4.5902

3.4500

1.1402 13.8

5.77 .7612

1.9014

79.6 Volts

5.3 Ohms Total

11° 23'

9.2952
4.6476
$\bar{2}$.4500
1.1976 15.7 Webers
.572 .7243
83.5 Volts 1.9219

4.95 Ohms Total

12° 42'

9.3421
1.6710
$\bar{2}$.4500
.2210 16.6 Webers
4.95 .6946
1.9256
84.3 Volts

4.25 Ohms Total

17° 54'
4.22 Ohms

9.4876
4.7438
$\bar{2}$.4500
423 1.2938 19.6 webers
.6263
83.2 Volts 1.9201

22° 9'
3.75 Ohm Total

9.5763
4.7881
$\bar{2}$.4500
1.3381 21.7 Webers
3.75 .5740
1.9021 79.8 Volts

Gramme 1040

25° 2'

3.5 Ohms total
3.6

25° 2'

L 9.6264
4.8132
2.4.00
1.3632   23.0 Webers
3.55   .5502
1.9134

81.9 Volts

1.3632
1.3632
3.5   0.5441
44.2   1.6459
4.9159

82400

Result Gramme 1040 105 revo

	Ohms	Volts	Webers	per H.P.
p.100	6.74	75.9	11.1	8.47
p.90	6.1	83.1	13.6	5.65
p.101	5.77	79.6	13.8	
p.102	5.3	83.5	15.7	
p.102	4.95	84.3	16.6	
p.103	4.22	83.2	19.6	
p.88	3.95	82.9	21.1	
p 87	3.8	79.8	21.1	
p.103	3.75	79.8	21.7	
p.104	3.55	81.7	23.	1.9
	3.5	82.7	23.6	
	2.92	79.4	27.2	
	2.32	68.7	29.6	
[illegible]	5.25	64.1	12.2	
p.	4.4	75.8	16.2	
	2.7	59.8	27.	
p.201	4.1	84.2	20.5	

~~New machine 840 revs.~~

Frame

~~2.55~~

36° 20'

3.5 ohms total

(9.6469

4.8234

2.4500

1.3734 23.6 Weber

3.5 .5441

1.9175

~~[illegible]~~ Volts

82.7

36°

2.92 ohms total

2 (9.7692

4.8846

2.4500

1.4346 27.2 Webers

292 .4654

1.9000 79.4 Volts

44° 10'

2.32 ohms [illegible]

(9.8430

4.9215

2.4500

1.4715 29.6 Webers

2.32 .3655

1.8370 68.7 Volts

4.1659

84.900 Volts

New Faradic Gramme on Field

2° 57

15.35 Ohm

(8,7115

4.3557 − 5

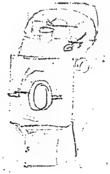
$\bar{2}$, 4506

0.9057   8,05 Weber

15.35 1.1860

2.0917

123 Volts



Gramme Machine.

The next to the largest Shoulder
To determine its constant

Standard cell	200
Daniells extremely well separation	193
No. 2	193
No. 3	193
	2)7.79
	3.89

4 cells 50 = D
4° 41'

91 = D

over .73 Ohm

3.89 .5899
1.09 .0374
.6273
4.23 Volts

.50)9.1

2.82	.2601
4.23	.6273
Comp .73	10.1367
	1.0241

10.5 Webers

2)8.91.19
4.4551
10.5 1.0241
3.4318
$\bar{2}$.4318

15° 48' No reversal

183 = D over

18° 30' 1/2 Ohm coil

annealing

~~196~~ 204

19° 30'

207

19°.40' about 80

5.0)204
4.08

4.08 .6273
.80 .6107
10.6969
1.3349 21.6 Webers
7.48

2)9.5126
4.7563
1.3349
3 4214
$\bar{2}$.4214

14° 55'

225 = D

R = .99 Ohms

5.0)225
4.5

.6273
.6532
.99 .0044
1.2849

19.2 Webers

9.4106
4.7053
1.2840
3.4204
$\bar{2}$.4204

$\bar{2}$.4318
$\bar{2}$.4214
$\bar{2}$.4204

say $\bar{2}$.4250

10° 391

4.22 Ohms

42

18° 101

3.13 Ohms

$20^\circ 45' = $ [illegible]

2.55 ohm

$23^\circ 16'$

2.15

$22^\circ 16'$

$C = c' + c'' = \frac{1}{R'} + \frac{1}{R''} = \frac{1}{R}$

$\frac{R' + R''}{R'R''} = \frac{1}{R}$

$R = \frac{R'R''}{R' + R''}$

~~ohm = 1~~ $R' = 1$

$R'' = 10$ ohm

.11

$\frac{10}{101}$ $\qquad \frac{1}{\frac{101}{10}} = \frac{10}{101}$

why I knew not

21° 30'   1060 revs   Belt slipped badly

1.7 Ohms Total

1.3570
1.3570
.3304
.6454

3.5908 abound

9.5640

4.7820
$\bar{2}$.4250

6.3570

1.3570   22.7 Webers

1.7   .3300

1.6874

48.6 Volts

Belt slipped

The dynamometer did not do well think it is placed so that the earths magnetism effects it a ~~[illegible]~~ ~~the north~~ Perhaps the engine was running slow

why I know not

25° 40'

1.55 Ohms

1.3933
1.3933

2 | 9.6366

4.8183

~~1.55~~ $\bar{2}$.4250

1.3933   24.7 Webers

This does not agree in the least with results previously obtained

4.8183
$\bar{2}$.3771

1.[illegible]412   27.6 Webers

1.4412
1.55   .1903
44.   1.6435

4.6962

49,600 ft. lbs

Do not understand will investigate

say 30

1.4771
1.4771
.1903
1.6435

4.7880

61,300 ft. lbs.

150 L

19°

.53 Ohms

4.23
3
12.69 | 1.1035
.53 | 1.7243
1.3792

23.9 Webers

19°

(9.5126

4.7563
1.3792
3.3771
2.3771

[illegible] 3 ohms total

1.3792
1.3792
3 .4771
.6454

~~2 0 40~~

152 = D on .53 ohm

19°.38'

2.8 ohms Total

.53 ohms

19°.38' 1.3792
9.5263
4.7631
1.3792
3.3939
2.3939

1.3792
1.3792
0.4472
1.6435
4.4491

2.8
44

70.600

70.600 ft. lbs.

next page

4 Daniells April 10

50 L

4.9 R

---

4 lamps p. 137 .80 Ohm

4

3 circuits 3)3.20

1.06 Ohm

1/2 machine 70600 ft. lbs.

35300 4.5478

.12 1.0792

3.4686

2940 1.1761

15 candles 2.2925

196 ft. lbs. per candle

15 candles to Lamp

175 = D

on .95 Ohm

10° 17'

3.65 Total

---

50)175 60

3.5 500

4.23 .5441

grade .95 .6263

10.0.2223

1.1927

15.5 Webers

10° 17'

L 9.2516

4.6758

1.1927

~~.8685~~

3.4831

$\bar{2}$.4831

195 = n

11° 57' .92 Ohms

50 / 195
3.9

/ 195
3.9

3.9 .5911
4.23 .6263
comp .92 .0362
1.2536

18. Webers

2 / 9.3160
4.6580
1.2536
3.4044
$\bar{2}$.4044

109 = n

2° 5' 1.23 ohms

50 / 109
2.18
4.23
comp 1.23

.3385
.6263
9.9101 − 10
.8749

7.5 Webers

2° 5'

/ 8.5605
4.2802
.8749
3.4053
$\bar{2}$.4053

180 = D

5° 20'

1.24 Ohm

54/180

3.6

4.23

Comp 1.24

.5563

.6263

9.9066

1.0892

12.2 Webers

8.9682

~~1.0892~~

4.4841

1.0892

.3949

$\bar{2}.3949$

210 = D

1.27 Ohm

10° 5'

54/210

4.

4.2

4.23

Comp 1.27

.6332

.6263

.8962

.10

1.155

1.1557

14.3 Webers

9.2432

4.6216

1.1557

3.4659

3.4659 Constant

13° 35'

or .91 Ohms

1215 = D

4.3

.6335

.6263

Comp

10.0410

1.3008

20 weber

2.9.3708

4.6864

1.3008

3.3856

$\bar{2}.3856$

NCG.

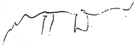
On lamp

$4^{0}\ 40'$

$5^{0}\ 18'$

4.2 Ohms

D



.88

$$\begin{array}{r} 1.67 \\ 88 \\ \hline .79 \end{array}$$ Ohm

D = 230 R

230 over 1.67

~~60)230~~

4.6

4.23

1.67

11.4

$$\begin{array}{r} .6628 \\ .6263 \\ \hline 1.2891 \\ .2227 \\ \hline 1.0664 \end{array}$$

$$\begin{array}{r} 1.0664 \\ 1.0664 \\ 1.5776 \\ 1.6035 \\ \hline 3.6739 \end{array}$$

.79

44

4720

$$\begin{array}{r} 33,000\ 4.5185 \\ 3.6739 \\ \hline .8446 \end{array}$$

6.9 Lamps per H.P.

114 = D

.93 Ohm

210 = D

2.28
4.23
Comp. .9310

.4440
.6263
3.15

1.69
1.1018 .93

.76

2.28

3579

50)200
4.2 .6232
4.23 .6263
1.2495
1.69 .2279
1.0216
1.0216
.76 1.8808
.44 1.6435
3700 3.5675

3700
4.5185
3.5675
.9510

9 per -.P

120
$4^0 \; 40^6$

120 = D over .95 Ohm

1.58
.95
.63 Ohms

200 = D

4.23
4
1.69 2

1.2279
.1987
1.0292
1.0292
3100
63 1.7993
44 1.6435
3.5012

$$\frac{155}{155} = D$$

4° 57'

1.2 ohms

250 = D

$$\begin{array}{r} 1.91 \\ 1.55 \\ \hline .46 \end{array}$$ ohms

$$5\overline{)15.5}$$
3.1

	3.1	.4914
	5.23	.6263
comp	1.2	9.9208 - 10
		1.0385

10.9 Webers

4° 57 $2\overline{)8.9359}$

$$\begin{array}{r} 4.4679 \\ 1.0385 \\ \hline 3.4294 \\ \bar{2}.4294 \end{array}$$

The zero point had changed

Tried to determine the amount H.P. used the resistance of the lamp being determined by substitution. Mly as the field of the magneto did not make in the same way.

3° 30' Quite fair determination

.75 Ohm

2 (8.7856

4.3978 - 5

$\bar{2}$.4000

.9978

9.95 Webers

.9978

.9978

.75 $\bar{1}$,8751

44.2 1.6454

3.5161

3.280

32000 4.5185

3.5161

1.0624

10. Per H.P.

white

Lamp bright yellow

.77 Ohm

4° 2'

(8.8471

4.4235

$\bar{2}$.4000

1.0235

1.0235

.77 $\bar{1}$.8865

44.2 1.6454

3.5789

3800.

4.5185

3.5789

.9396

8.7 per H.P.

This is somewhat too small as I did not deduct enough for my leading wires

... webers

May 10 new machine

on 3rd case from end

1185 revolutions.

Standard Daniells 200

no 1 196

$\frac{196}{2}$

3.88

4 | 7.88 200 | 7.88

1.97 3.94 Daniells

3.94 .5955

1.09 .0374

.6329

4.29 Volts

50 = D for 4 Daniells

72 = D

2° 27'

on .76 Ohm Architecture

.50|72

1.24

4.29

.0934

.6325

comp. .76 10.1192

.8451

7.0 Webers

8.6309

3.4703

2.4703

140

~~13 0 = D~~

~~.92 Ohms~~

~~3° 47'~~ N.G.

175

1.10 Ohms

6° 33'

8.2 Ohms total

50 / 1.75

3.5 .5441

4.29 .6325

comp 1.10 9.9586

13.5 Webers 1.1352

Constant 2.3933

9.0571

4.5285

1.1352

33933

~~D75~~ (X)

~~May 9~~ P.M

50 = D 4 Daniells

179

1.08 Ohms

6° 22'

50 / 179

3.58 .5539

4.29 .6325

comp 4.08 9.9666 −10

14.2 Webers 1.1530

9.0449

4.5224

1.1530

33694

2.3694

180

1,12

6° 12'

50 / 180
3.6
4.29

.5563
.6325
1.12 9.9508
1.1396

13.7

2 (9.0334
4.5167
1.1396
3.3771
2.3771

206

1.15

~~6.15~~

210

8° 46'

1.14 Ohms

1 ohm coil smoking

50 / 210
4.2
4.29

.6232
.6325
1.14 9.9931 - 10
1.1988

15.8 Webers

2 (9.1830
4.5915
1.1988
3.3927
2.3927

2° 26.   106 = 0

2° 20'

1.1 Ohm

50/104
2.08
4.29

.3151
.6325
comp 1.1 9.9586 - 10
0.9092

8.1 Webers 0

.9092

32.63
31.51
1.82

8.6397
4.3048
.9092
3.4056
2.4056
1.82
2.3974

50/106
2.12

.3263
.6325
9.9586
8

284
264

1.16 Ohms   13° 4'

50/264
5.28

.7226
.6325
comp 1.16 .9355
1.2906

19.5

19.35 2
4.6771
1.2906
3.3865
2.3865

264

1.16 Ohms   13° 4'

1.13

170 = D

5° 49'   .164

5.0 / 17.0
3.4
4.29

comp 1.13

.5315
.6325
.9464
1.1109

12.9 weber

9.0058
4.5029
1.1109
3.4920
2.4920

Total 12.75

2° = D

8.5428
4.2714
3.40 [illegible]
8.[illegible]
12.75   1.1053
4.9761

7.43 Webers

94 Volts on 12.75 Total

There is a constant of 4° to the left from the current

228 L - 4

1.14 Ohms

$50\overline{)228}$
456

10° 36'

$50\overline{)1.14}$
.228

3579
6590
6474
126

$50\overline{)22.4}$
4.47
4.29

.6474
.6325
const 1.14 9.9431
1.2230

16.7 Webers

9.2647
4.6323
1.2230
3.3993
2.3993
1.26
2.4867

16.7 Webers

6

85 L

1.10 Ohms

~~1° 37'~~ 1° 37'

$5.0\overline{)8.1}$
1.62

.2095
.6325
1.10 9.9556
.8006

6.32 Webers

1°37

$2\overline{)8.4504}$
4.2252
.8006
3.4246
2.4246

.164

i.1

6° 54'

8.5 Ohms total

50/164

3.28 .5159

4.29 .6325

anti l. 9.9547 -10

12.6 ~~[illegible]~~ 1.1031 Webers

8.6 .9345

9.0796 1.0376

4.5398 log Volts

1.1031

3.4367

$\bar{2}$.4367

Results

		Webers	
4° 41'		10.5	$\bar{2}$.4318
19° 40'		21.6	$\bar{2}$.4214
14° 55		19.2	$\bar{2}$.4204
19°		23.9	$\bar{2}$.3771
19° 38		28.0	$\bar{2}$.3939
10° 17'		15.5	$\bar{2}$.4531
11° 57'		18	$\bar{2}$.4644
2° 5'		7.5	$\bar{2}$.4053
5° 20		12.2	$\bar{2}$.3949
10° 5'		20.	$\bar{2}$.3856
6° 33'		13.5	$\bar{2}$.3933
6° 22		14.2	$\bar{2}$.3674
6° 12		13.7	$\bar{2}$.3771
8° 46'		15.8	$\bar{2}$.3927
2° 20		8.1	$\bar{2}$.3974
13° 4		19.5	$\bar{2}$.3865
5° 49'		12.9	$\bar{2}$.4720
Calculated		7.43	$\bar{2}$.3993
10° 36'		16.9	$\bar{2}$.4246
7° 37'		6.3	
6° 54'		12.6	$\bar{2}$.4367

What is the trouble?

~~Drill charge~~

The wires in dynamometer cannot make so great variations.

The galvanometer ~~it~~ seems to be reliable, and I know the principle is correct.

The measurements of the resistances are nearly right as they agree within 1% of each other.

must find out

Perhaps I have not taken care enough

12|9½

	Webers	
1° 37	6.3	$\bar{2}$.4246
2° 5'	7.5	$\bar{2}$.4053
2° 20	8.1	$\bar{2}$.3974
4° 4	10.5	$\bar{2}$.4318
5° 20'	12.2	$\bar{2}$.3949
5° 49'	12.9	$\bar{2}$.4920
6° 12'	13.7	$\bar{2}$.3771
6° 22'	14.2	$\bar{2}$.3694
6° 33'	13.5	$\bar{2}$.3949
6° 54	12.6	$\bar{2}$.4367
8° 44'	15.4	$\bar{2}$.3627
10° 17'	15.5	$\bar{2}$.4351
10° 36'	16.7	$\bar{2}$.3993
11° 57	18.7	$\bar{2}$.4044
13° 4	19.5	[illegible]
14° 55	19.2	$\bar{2}$.4[illegible]
19°	23.9	$\bar{2}$.[illegible]
19° 35	24.9	[illegible]
19° 45'	21.6 ~~At~~	[illegible]

May 10

Standard	200 L
No. 1	194 L
No. 2	195 L
No. 3	198 L

No. 2	195 R
No. 3	198 L

Made No 3	100 L
No 2	100 R

Both together 204 to the right

No 2	100 L
Nos 2 & 3	200 L
	201

Fixed the galvanometer so that the scale was at right angles to the ray at zero. Placed it slightly further away, leveled it carefully

No. 2	100 L
3	100 R
Nos 2 3	201 L
Standard	102
No. 1	100
Standard No. 1	202

Current gave 16 to left when galvanometer

2 | 197

394

3.44 .5955
1.09 .0374
.6329

4.29 Volts

4 Daniells

$D = 50$

$D = 2L$ ~~when~~ from current

$335\ L$ $\quad 50\,/\,33.5 \quad 6.7$

11° 4'

1.14 Ohms

$$\begin{array}{r} 1.14 \\ 5 \\ \hline 1.09 \end{array}$$

4.29 — .6329

6.7 — .8261

~~.6314~~

$$\begin{array}{r} .6329 \\ .8261 \\ 9.9626 - 10 \\ \hline 1.4216 \end{array}$$

26.4

$$\begin{array}{r} 2 \; \lvert 9.2831 \\ \hline 4.6415 \\ 1.4216 \\ \hline 3.2199 \\ \bar{2}.2199 \end{array}$$

.05 in connecting wire

41

16'

1.08 Ohms

$$\begin{array}{r} 1.08 \\ 5 \\ \hline 1.03 \end{array}$$

$50\,/\,41$ $\quad .82 \quad 4.29$

$$\begin{array}{r} \bar{1}.9138 \\ .6329 \\ 9.9656 \\ \hline .5133 \end{array}$$

3.27 webers

16'

$$\begin{array}{r} 17.6678 \\ \hline 3.8339 \\ .5133 \\ \hline 3.3206 \\ \bar{2}.3206 \end{array}$$

158

118 L
2
116

1,15 ohms
5
1,10

1° 37'

50 | 116
2,32
4,29
amp 1,15
8.65

.3655
.6325
9.9393
.9373
2.84504
42252
0.9373
3.2879
2.2879
1.08
5
1.03

2.2879

136
.2
134

2° 14'

50 | 134
2.68
4.29
amp 1.03
11.1 Webers

0.4281
0.6325
9.9872
1.0478
8.5907
4.2850
1.0478
3.2382
2.2382

1,14

159

134

2° 14'

107
5
1,02

10 | 775 | 77..
70
75
70
5

175
170
1

1,08 ohms 1,03
10.6 Total
3° 21.

175
775
875
1225
1225
135625
16
813750
135625
2170000

May 11 P.M.

4 Daniells 50

165 = D - 4 = 161
3° 14' .3.22
1.07 Ohms
.5
1.02

3.22 .5079
4.29 .6325
amp 1.02 9.9914 -10
1.1318

13.5 webers

2 | 8.7513
4.3756
1.1318
3.2438
$\bar{2}$.2438

222 = D - 4 = 218
221 = D 1.40 Ohms
~~225~~ 135
5 | 270
3° 14'

4.36 .6395
4.29 .6325
amp 1.35 9.8697 -10
1.1417

2 | 8.7513
4.3756
1.1417
3.2339

$\frac{1}{150}$ $\frac{1.775}{155}$

251 = D

244
4
240

$3^\circ\ 14'$

1,57 Ohms
5
1,52

50 | 240
4.8
4.29
comp 1.52

.6812
.6325
9.8182 -10
1.1319

13.5 Webers

260

$3^\circ\ 33'$

1.57 Ohms

260
4
50 | 2.56
5.12
4.29
comp 1,57

.7093
.6325
9.8041
1.1459

2 | 8.7918
4.3959
1.1459
3 25 00
2.2500

.50 for 4 Daniells

100
.96
.96
.98

1.49 − 4 = 145 = D

1.20 Ohms

3° 38′

50) 145
2.9 0.4624
4.29 0.6325
comp. 1.15 9.9393
10.8 Webers 1.0342

8.8058
4.4029
1.0342
3.3787
$\bar{2}$.3787

1.18 = D − 4 = 1.14

1.20 Ohms .05 = 1.15

2° 14′

50) 114
2.28 .3579
4.29 6325
1.15 9.9393
8.5 Webers .9297

8.5907
4.2953
.9297
$\bar{1}$.3656 constant

1~~5~~8 -4144

1.21 Ohms -5 1.16

$3^\circ 31'$

50 / 114.4

2.88 .4594

4.29 .6325

Comp 1.16 9.9355 - 10

1.0274

10.6 Webers

2 / 8.7877

4.3938 very good

1.0274

3.3664

D = 20~~0~~ - 4 194.

$6^\circ 22'$.

1.27 Ohms -5 1.25

50 / 194

3.88 .5888

4.29 .6325

Comp 1.25 9.9031

13.3 1.1244

/ 9.0449

4.5224

1.1244

3.3980

$\bar{2}$.3480

168

240 = ⊙ − 4   236

8° 36′

1.28 Ohms .05 1.23

50 / 236
4.72   .6739
4 29   .6325
Comp 1.23   9.9101 − 10
16.4 Webers   1.2165

2 / 9.1747
4.5873
1.2165
3.3708
2.3708

169

175 = ⊙ − 4 171

8° 39′

.95 Ohms − 5 90

50 (171
3.42   .5340
4.29   .6325
Comp .90   10.0458 − 10
1.2123

16. 3 Webers

175 27
775
87635
122689
122689
145834
167
1020838
875004
145834
24353278

215 — 4 211

12° 45'

.96 Ohm

.91

50) 21.1

.422

4.29 .6753

.6325

Comp .91 10.0410

1.2988

19.9

9.3438

4.6719

13689 4.13621 .2988

5.9 0.77093 .3831

3.36532 .3831

2317

5.0090

1.6435

2370 3.3655

5.9 Total

13° 12'

2) 9.3586

4.6793

~~2.3800~~

1.2993

19.9 5.9 .7709

2.0702

117 Volts 2.0702

.0374

107 Damells 2.0328

117 2.0682

117 2.0682

Comp 5.9 9.2291 − 10

44. 1.6435

102000 5.0090

4.5185

3.09 H.P. .4905

10.1 Ohms Totale

3° 2.8'

8,7815
4,3907
2,3800
1,0107

10, weber
1,0107
10.1 1,0043
2,0150

103 Volts

103 2.0128
103 2.0128
comp 10.1 8.9957
44. 1.6435
4.6648

No 1 Plate

94.925

No. 2 92.155

No. 3 irregular

69.647

No. 4.

98.688

May 14 1879 8-45 am

Standard Daniells

i = 200 L

No 1 cell	195 L	
No. 2 cell	196 L	
No 3 cell	200 R	
No 3 cell	200 L	
No 2 cell	199 R	cell $\frac{98}{100}$ R
No. 1. cell	195 L	Standard
Standard	203 R	
Standard	200 L	
	204 R	

4 cells 50 L

$$\begin{array}{r} 98 \\ 4 \\ \hline 392 \\ 1.09 \end{array}$$

$$\begin{array}{r} 9.5933 \\ .0374 \\ \hline .6307 \end{array}$$

4.27 Volts.

 Edison faradic machine

The coils connected in threes: magnet quantitized

1160 revolutions

$D = 146R$ over .92 Ohm

6°

.92 − 5 = 87

Current 4° D to right

146
4
50 / 142
2.84 .4533
4.27 .6307
Comp .87 10.0605 − 10
1.1445

13.95 Webers

2 / 9.0192
4.5096
1.1445
3.3651
$\bar{2}$.3651

170 R = D

7° 36′ over .95
.5
.90

170
4
50 / 164
3.28 .5159
4.27 .6304
Comp .90 10.0458 −10
15.5 Webers 1.1921

9.1214
4.5607
1.1921
3.3686
$\bar{2}$.3686

183 = D   over 1.28 Ohms

4° 53   5
1.23

183
4
50 (179
3.58
4.27
comp 1.23

12.7 webers

.5539
.6307
9.9201
1.1047

8.9300
4.4650
1.1047
3.3603
$\bar{2}$.3603

144 = D

9° 19'

.75
5
.70

~~2.83 Ohms Total~~

Constant $\bar{2}$ 3675

2 / 9.2092 - 10
4.6046 - 5
$\bar{2}$.3675

17.2 Webers   1.2371

144
4
(140
2.8
4.27
comp .70

17.08

.4472
.6307
9.1549 - 10
1.2328

4.6046
1.2328
3.3718
$\bar{2}$.3718

7° 57'

2.03 Ohms Total

Constant $\bar{2}.3617$.

	9.1408	
	4.5704	
	$\bar{2}$ 3675	
15.9 Webers	1.2029	
2.03	.3075	
	1.5104	32.4 Volts
1.09	.0374	
	1.4730	29.7 Daniells

4° 36'

2.38 Ohms Total

	8.9041	
	4.4525 -5	
	$\bar{2}$. 3675	
	1.0850	12.1 Webers
2.38	0.3765	
	1.4616	28.9 volts
	.0374	
	1.4242	26.6 Daniells

12° 28′

1.78 Ohms

2) 9.3342
4.6671
2.3675
1.2996 — 19.9 Webers
1.781 0.2504
1.5500 — 35.4 Volts
.0374
1.5126 — 32.4 Daniells

May 1880 note Magnets 24 in. by 4 in.
45 coils 3 layers 3 turns No. 18 wire
.056
Armature 6" diameter see plans
6" long
See Book 16
Magnets No. 13 wire .095 in
864 turns Batch

4° 5′
4° 16′ 2.53 Ohms

8.8612
4.4306
2.3675
1.0631 — 11.5 Webers
2.53 .3979
1.4610 — 28.9 Volts
.0374
1.423 — 26.5

Twines 15" coils
Magnets quantitied
20) 32.4 (16 Webers
8 Webers each magnet
8 X 864 = 6672 strength
6672

1.2 Ohms

31° 28′

9.7176

4,5558

$\bar{2}$.3675

1.4913 — 3,, Weber

1.2 — .0792

1.5705 — 37.2 Volts

.0374

1.5331 — 34.1 Daniells

540 revolutions

4° 6′

over 1.10

8.5542

[illegible]

$\bar{3}$.3[illegible]

1.0[illegible] — 11.4

.04[illegible]

1.1010 — 12.6 Volts

.0374

1.07[illegible]6 — 11.8 Daniells

6° .98 . Total

9.0092 - 10
4.5046 - 5
$\bar{2}$.3675
1.1371
.98 $\bar{1}$.9912
1.1283

13.7 Weber
13.4 Volts

1.1371
1.1283
1.6464
3.9118

8.160 ft lbs

$\frac{1}{4}$ H.P

1° 22' 1.51 Ohms

8.3775
4.1887
$\bar{2}$.3675
.8212
1.51 .1790
1.0002

6.62 Weber
10 Volts

8212
10002
18214
16464
3.4678

[illegible] ft lbs

$\frac{1}{10}$ H.P

Speed faster. 800 revolution

5° 16'   1,54 Ohms

18.9628
4.4814
2.3675
1.1139   13. Webers
1,54   .1875
1.3014   20. Volts
.0374
1,2640   18.3 Daniels

1,1139
1,3014
1,6464
4.0617   11,550

1/3 H.P.

18° 58'

1,01 Ohms

19.5119
4.7559
2.3675
1.3884   24.4 Webers
.0043
1.[illegible]927
.[illegible]74
1,3553

1,3884
[illegible]
[illegible]
[illegible]
4.[illegible]75   26.[illegible]

$1^\circ\ 56'$

2.04 Ohms

8.5281
4.2641
$\bar{2}.3675$
.8966 — 7.88
2.04 .3096
1.2062 — 16. Volts
.0374
1.1688 — 14.7

.8966
.8966
.3096
44.3 1.6464
− 3.7492 — 5.610 ft lbs
+ 4.5185
.7693 — $\frac{1}{5.8}$ H. P

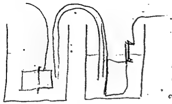
$19^\circ\ 27'$

1.02 Ohms

9.5224
4.7612
$\bar{2}.3675$
1.02 1.3937 — 24.7 Volts
.0088
1.4025 — 25.2 Volts
.0374
1.3[illegible] — [illegible]

1.3937
1.3937
.3096
1.6464
1.442[illegible] — 27[illegible]

Monday June 9 1879



Standard
Daniells

Zn well amalgamated
Concentrated solution Zn Sulphate
Con. Cu SO4

Cu Tube containing acid
~~Water~~ H2O before the
water was acidulated
its resistance was so great
as ~~to~~ affect the galvanometer
over 1/3.

Resistance in line about
~~£~~ 55.000 Ohms

D = 230 Standard
~~No~~ D4 = 215 No. 1
227 No. 2
200 No. 3 circuit just
200 opened.

D = 237 R Standard
235 L
233 R

Standard 40
No 1 ~~do~~ 70

4 cells. 200

215
227
200
235
877

877
235

2.9430
.3711
.5717
.0374
.6093

3.73 Daniells
1.09
4.07 Volts

194 Fiducial $5^\circ\ 31'$ R

$5^\circ\ 28'$

Gramme 265.0

over .96 Ohm

$1^\circ\ 38'$ R

2.65	.4232
Volts 4.07	.6096
comp .96	19.0177 −10
	1.0505

11.2 Webers

$5^\circ\ 30'$
$1\ \ 38'$
$3^\circ\ 52'$

~~8.8288~~

2) 8.8288
4.4144
1.0505
3.3639
5
$\bar{2}$.3639 Constant.

D = 335.0

over 1 Ohm

1° 20 L

Total cold
5.4 Ohm

3.35	.5250
4.07	.6097
	1.1347

13.6 Weber

$5^\circ\ 30$
$1^\circ\ 20'$
$6^\circ\ 50$

2) 9.0754
4.5377
1.1347
3.4030
5
$\bar{2}$.4030 = Constant.

13.6 . 1.1347
5.4 . .7324

1.8671
73.6 Volts 1.1347
3.0018 1002
44.5 1.6484
3.6502
44,600. foot lbs

 June 9. P. M.

No. 1 200

No 2 200

No 3 200

Standard 205

Made the four = 50

$C_1 = \sqrt{\sin^2 D_1}$ $\quad C_1^2 =$

$C_2 = \sqrt{\sin^2 D_2}$

$\frac{C_2}{C_1} = \frac{\sqrt{\sin^2 D_2}}{\sqrt{\sin^2 D_1}}$ $\quad \sin D_1 = C_1^2$

$\sin D_2 = C_2^2$

$\frac{C_2}{C_1} = \frac{\sqrt{\sin D_2}}{\sqrt{\sin^2 D_1}}$ $\quad \frac{C_2}{C_1} = \frac{\sqrt{\sin D_2}}{\sqrt{\sin D_1}}$

$C_1 = \frac{\sqrt{\sin D_1}}{\sqrt{\sin D_2}} C_2$

$C_1 = \sqrt{\sin D_1}$ / Weber

$C_1 = \frac{\sqrt{\sin D_2}}{C_2}$

~~$\sin C_1 =$~~

$\frac{C_1}{C_2} = \frac{\sqrt{\sin D_1}}{\sqrt{\sin D_2}}$

$\frac{C_1}{\sqrt{\sin D_1}} = \frac{C_2}{\sqrt{\sin D_2}}$

$\frac{C_3}{\sqrt{\sin D_3}} = \frac{C_1}{\sqrt{\sin D_1}}$

$C_3 = \frac{\cancel{C_1}}{\sqrt{\sin D_1}} \sqrt{\sin D_3} = \frac{\sqrt{\sin D_3}}{\sqrt{\sin D_1}}$

$\sqrt{\sin D_1} = \frac{\sqrt{\sin D_3}}{C_3}$

205) 805 (4

805 20#

805
205
3.92 Dan
4.28

.9058
.3138
.5940
.0374
.6314

Fiducial 5° 23'

D = 150
= 145 12' R

over .96 Ohm

50/148
2.96 .4713
4.28 .6314
comp .96 .0177
1.1204 13.2 Webers

5° 23'
12'
5° 11

2/8.9558 -10
4/4779 - 5
1.1204
$\bar{2}$.3575 - 0 Constant

suppose 4.4779 - 5
2.3373
13.8 Webers 1.1406

.4713
.6314
.91 .0410
1.1437 13.9 Webers

4.4779
1.1437
$\bar{2}$.3342 Constant

D = 55 over .95
4° 43'

5°/55
1.1 .0414
4.28 .6318
.95 .0223
.6955 4.96 Webers

5° 23
4° 43
40'

2/8.0657
4.3328
.6955
$\bar{2}$ 3373 Constant

.0414
.6318
comp. .90 .0458
.7190 5.24 Webers

4.0328
.7190
$\bar{2}$.3138 constant

D = 208 over ~~4~~1.32 Ohms

5' R

50/208
4.16 .6191
4.28 .6314
Comp 1.32 9.8794 -10
1.1299

13.5 Webers

5° 23'
5'
5° 18'

2/8.9655
4.4827
1.1299
2.3528 Constant

.6191
.6314
1.27 9.8962 -10
1.1477

14.05

4.4827
1.1477
$\bar{2}$.3350 Constant

D = 240 over 1 Ohm

7° L

Total 4.1

50/240
4.8
4.28

.5812
.6314
1.3126
4.1 .6128
1.9254

20.5 Webers
84.2 Volts

7°
5° 23'
12° 23'

2/1.3313
4.6656
1.3126
$\bar{2}$.3530

Substract ~~Add~~ .05 for resistance leading wires

.5812
.6314
.95 .0223
1.3349

21.6 Webers

Total 3.96 .5977
1.9326

85.6 Volts

4.6656
1.3349
$\bar{2}$.3307 Constant

5° 28' Fiducial

.56 Ohm in lamps

2°.58'

5°.38' Fiducial

Wires .047 Ohm to be taken from all measurements

Connecting wires in lamp .0250 Ohm

.01

.035 total to be taken from lamp

.035
.047
.082

.56
.082
.458 in lamp

5° 38
2 58
2° 40

10 Webers

8.6676
4.3338 - 5
2.3300
1.0038

100 .458 44.5 2040

2.
1.5009
1.6609
1.6484
3.3093

35000

4.5185
3.3093
1.2092

16.1 per H.P.

204 Page 137

suppose 10 Weber
and .7 Ohm in lamps

$\overset{2}{\bar{1}}.8451$

44.5 1.6484

3.~~4~~935

3170

45185

3.4935

1.0250

~~8.00700 H.P.~~ 10.57 H.P.

Instead of 8.7 per H.P. which shows the need of accuracy.

Gramme 1040 revs with lamp 1205

70 to L! no current.

4 Daniell - 5

120 to L over .65 - .05 = .60

115

5° 2'

115 L

~~8.0~~ 110 L .64 - 5 = .5 ~~4~~ ohm

4° 30

4° 23' 6.3 ohm Total

L 110

June 10

Standard 200

200

No. 3 195

No. 2 205 205

No. 1 200 [illegible]

 June 10 P.M.

~~#25~~ 4 Daniells . 50

268 revs.

New machine slowest speed driven by Gramme

3° 22' Current on dynamo

105 Δ on Galvanometer

95 over 1.65 Ohms

Total 9.1 Ohms

New Machine Gramme on magnets 109

30 / 105. June 10 268 revs

		109
		4
		436
2.1	.3222	
4.36	.6395	
comp. 1.65	9.7825 - 10	
	.7442	5.55 Weber
9.1	.7442	
5.55	.9590	
	1.7032	50.5 Volts

3° 22' 2 / 8.7688

4.2844

5.3300

1.0544 11.2 Weber

on Magnet

Suppose constant 5.3500

1.0344 10.8 Webers

June 10

Same 11.2 Webers from Gramme Magnets

100 R on new machine

over 1.34 Ohms

Total resistance = 7.7

4.36
2.

8.72 .9405

Comp. 1.34 9.8961 10

.8166 6.55

7.7 .8865

1.7031 50.4 Volts

.8156

.8166

.8865

44.5 1.6484

41681 14.700 foot lbs

total from new machine

Current on magnet 10 5 6'

June 10

New machine

95 R over 1.32

Total 7.3 Ohms

85241

4.26 20

2.33 00

.9320 8.55 Webers

95

1.9 .2788

4.36 .5175

Comp. 1.32

.7977 6.26 Webers

.9320 7.3 .8633

.9320 1.6610 45.7 Volts

1.5484

3.5124

3255 foot lbs on magnet

June 10

11.2 : 8.55 :: 50.4 : 38.5

50.4	1.7031
8.55	.9320
amp. 11.2	8.9508
	1.5859

If the E.M.F falls proportionally to the current of the magnet it should have been 38.5 instead of 45.7 Volts.

~~If it fell as the square~~

If the square of the E.M.F. fell

$11.2 : 8.55 :: 50.4^2 : x^2$

This is quite near see pp. 229-33[illegible]

June 10

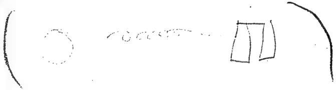
1.7031
1.7031
.9320
8.9508

$2\overline{)3.2890}$

1.6445

instead of 45.7

44.5 E.M.F



11.2
11.2
44.5
[illegible]

5450 [illegible]

3.7368

Magnet [illegible]

New machine [illegible]

[illegible]

214 Wednesday June 11. 1879.

No. 1 Daniell 220
No. 2 220
210 L
220 L

No 1 215 L
Standard 215 L
225 R

4 cells 50 $\frac{100}{428}$

shall take Daniells as 1.07 Volts as the Standard was the same as the other cells

June 11 215

New machine speed 268 revs on its own field

Very slow in coming up

190 L over 1.67

2° 47' consider the leading wires as about equalling the loss by delay in measuring.

50 / 190
3.8
4.28
Comp 1.67

2° 47

.5798
.6314
.7773
.9885

9.74 webers

2) 8.6862
4.3431
.9885
3.3546

185 1.68

2° 26'

6.20 after 2 minutes
6.25 on account of discharge of magnet

probably 6.3

50 / 1.85
3.7
4.28
comp 1.68

.5682
.6314
9.7747 -10
.9743

9.42 Webers

2° 26'
18.6279
4.3139
9743
2.3396

9.42 .9743
6.3 .7993
1.7736 59.3 Volts

I do not understand how this is! for yesterday having the Gramme machine on the field giving a current of 11.2 Webers the Edison only gave an E. M. F. of 50.4 Volts!

See page 223 where reading today shows an E. M. F. of 60.5 there being 8.26 Webers on field.

Yesterday's reading perhaps wrong
The speeds were the same by measurement

155 Ω over 136 - .045
= 1.315
1.32

2° 55′

After one minute 1.34
Two 1.33

6.35 Ohm . one minute after
half

50/155
3.1
4.28
Comp 1.32

.4914
.6314
9.8794 - 10
1.0026

10.05

2° 55

(8.7065
4.3532
1.0026
3.3506

.63,5 Volts

Perhaps having the ~~armature~~ magnet in circuit may increase this E.M.F. acting as a reservoir to bridge over small variations. Not so.

Ex. Put the armature through the magnet and test its E.M.F. also without magnet in circuit.
No dif.

Found that the Dynamometer must be shaken as it is sluggish in movement. Dust the reason for this on the surface of the Hg.

150 R over 1.33 - 4.5

1.29

2° 53'.

6:3 about seven minutes after stopping machine

.50/150
3.0
Comp

4.28
3
12.84
1.3

1.1072
9.8861
.9933 9.15

9.85 Webers

2' 53

18.7015
4.3507
.7933
2.3574

9.85 .9933
6.3 .7993
1.7926

62 Volts

Hg Gramme machine

1040 revo. Large magnet in circuit

180R

The dust on the Hg. on the Dynamometer seemed to cling to the points and dampen very strongly the vibration the ~~instrument~~ points were moved forcing them. Seem dust

 June 11

Gramme

182 R over 1.35 —

3° 48 Total 6.45

50/182
3.64 .5611
4.28 .6314
Comp 1.35 9.8697
1.0622 11.5

6.45 .8096
11.5 1.0622
1.8718 74.4 Volts

3° 48 (8.8213
4.4106
1.0622
$\bar{2}$.3474 Constant

June 11 P.M.

Gramme of field 2° 56.1
Total 5.32

50/170 R over 1.32 - .05
.1.28
3.4 .5315
4.28 .6314
Comp 1.28 9.8928 -10
1.0557 11.3 Webers
5.32 .7259
1.7816 60.5 Volts

On field

1° 56' (8.5243
4.2621
$\bar{2}$.3450
.9171 8.26 Webers

Revolutions 268 per minute
none lost by belt slipping

Gramme 3'

Total 5,4 Ohms

150 R over 1.34 Ohms
5
1.29

8.7188
4.3594
$\bar{2}$.3435-0
1.0144 10,3 Webers

180 2,2553 New Machine
52 1.7160
.5393
3.46 .6314
4,28 9.8729
Comb 1.34 1.0436 11,0 Webers
5,4 .7324
1.7760 59.7 Volts

Short circuiting brought up the field in from 135R ~~190R~~ to 140R

When Gramme taken off 15R over 1.28 Ohms

First 20 then in about a minute 15 and two minutes 10 etc

Opened the circuit so that the galvanometer formed part of the circuit 51 to the right from the permanent magnetism

42 Volts

A sounder placed in the circuit opened — break. Mr. E. found that it was due to lack of pressure on the commutators.

June 11 P.M.

New Machine ~~Gramme on field~~

77' 50' 5.35 Ohms Total

Gramme on field
160 on
1.32

50 2 | 8.1626
4.0813
3.3450
.7363
5.35 .7284
1.4647

5.45 Webers

29.1 Volts

Gramme 160 ×2

2.2041
1.7160
.4881

428

Comp. 1 3

June 11 P.M.

Gramme on Galv

186 to left

New on Dynamometer

Gramme on Calorimeter

7561
2268427
2,275,988
184700
2,460,688
2,457,162
9,526
2266
2259700

175.27
775
87635
122689
122689
135834~~25~~
16.7
950838
~~815004~~
815004
135834
226,8427.8
300 | 2,268,427
7561

 June 11 P.M. New Machine

Gramme Dynamometer

~~1st~~

175 L 2° 14'

130 L 1°.49'

35 L 23'

280 L 2° 46'

Total Types Brass

4 Daniells 526 R
52 L

Perhaps the constant of Dynamometer has changed as I cleaned the Hg.

June 11 P.M.

Gramme

52)175(3.36
156
190
156
340

3.36
4.28
1.29 Const.

.5263
.6314
.8894
1.9471

.5208

11.1 Weber

2°.14

18.5499
4.2949
2.3450
.7299
6.3 .7993
1.7292

8.51 Webers

~~54.4~~ Volts
53.6

52)130(2.46
104
260
208
320

2.46

.3909
.5208
.9117

Gramme

8.15 Weber

1°.49'

18.5010
4.2505
2.3450
.9055
6.3 .7292
1.6327

8.04

42 Volts

23′ | 7.8254 |

3.9127
$\bar{2}$.3450
.2577 — 1.82 Webers

52)350(.67
312
380
364
160

7.8261
.5208
.3469 — 2.22 W
.7000
1.0469 — 11.2 Volts

52)280(5.57
260
200
260
400

.7459
.5208
1.2667 — 18.4 Webers

2° 46′

4.3418
$\bar{2}$.3300
1.0118 — 10.2
.7292
1.7410 — 55.1 Volts

1.6836
4.3418
$\bar{2}$.3450
.9968 — 9.93 Webers
.7292
1.7260 — 53.2 Volts

11.1 ; 8.15 :: 8.51 ; ~~8.4~~ X

62.7

.9117
9.9299
8.9529 −10
8.7945

X^2

.9117
.9299
.9299
8.9529
1.7444 — 55.5
.8722 — 7.45 − x^2

8.15 : 1.82 :: 8.04 : X

9.0883−10
.2577
.9055
.2515
1.78

9.0883−10
.2577
.9055
.9055
2)1.2570
.6285
4.25

 June 11. 1879 P. M.

As the magnet is nearly saturated the ~~E.M.F. of ctups~~ square of the E.M.F. are proportional to the strength of the current around the magnet. see p. 212.
The law for this to be thoroughly tested

June 11 8 P. M.

New Standard cell

Thoroughly amalgamated Zn In solution ( ) Zn. a siphon used to connect this with a saturated solution of $Cu\,SO_4$ having a Cu. plate in it.

$R = 2000\ L \quad D = 20°\ R$

another cell the same only having a porous cup in place of siphon to separate the fluids

$D = 206\ L$ [illegible]

The resistance of the first must be very great as there are about 60 ohms in the line and its E.M.F. is also nearly the same, for when the two are connected opposing a deflection of 5 to left is obtained

 June 11

showing that the cell with porous cup has the greater E. M. F. D=5

2.5 % greater

Zn in Porous No. 1
" " Siphon No. 2

Now why?

Took the solutions and Zns. from the cell with siphon and put in porous cell 200 L. 205 R.

Changed Zns

205 L 206 R
205 L

0 | 0
205 L
206 R

Changed to Zn from Siphon

205 L
206 R

June 11

In the siphon cell No. 1 Zns.

203 R
200 L

allowed a little air to leak over into the Zn cell no change

Against each other 2 L
1 R

Constant deflection in R made 0

against each other 0
1 R
2 L

Siphon 200 R
Porous 205 R
Siphon 202 L
Porous 205 L

No. 3 185 L
No. 2 202 L

No. 2 and Siphon
5 L

Siphon 200 L
No 3 200 L
Side by side 200

Siphon 202 R
No. 2 202 R

Siphon about 4 R stronger

0

Siphon 201 R
Porous 205 R

against each other 0 "exact"
~~Siphon 205 L~~
Porous 205 L
Siphon 200 L
against each other 0 exact
The siphon has a very large resistance and at first ~~was~~ had fluids of different density in it. Also some unknown disturbance perhaps moisture on wire etc. Better use the porous cups as being more exact

porous and no. 3 20 R
23 L
porous 20 stronger

porous 205 R 205 L
No. 3 180 R

 June 11 singly

The difference of E.M.F
is greater than the difference
when placed against each
other

Internal resistance
of Siphon battery 1200 Ohms

June 12 1879

Standard 200 R & L forms
No. 3 185 ~~RLR~~
No. 2 197
No. 1 190 L 192 R
Standard 200 L

No 1 192 R
No. 4 a new cell fluids badly
mixed 170 right
No. 2 193 L
190 L
No. 1 190 L
No 3 new 192 L
Standard 200

Newly arm — June 12 A.M

No. 1	192 L	192 R
No. 2	190 L	192 R
No 3	193 L	192 R
Stand	200 L	200 R

New machine

D = 210 — 1.62 Ohm

4° 26' 5.7 ohm total

1210
4.2
4.23
Comp 1.62
11.0 Weber

.6232
.6263
9.7905
1.0400

192
192
192
200
200/1776
3.88

388
109
3492
388
42292

268 revs

4° 26'

8.8881
4.4443
1.0400
3.4040 constant

5.7
11
57
57
62.7 Volts

 June 12 a.m.

D = 214   1.33 Ohms

268 rev   -.4 = 1.29

7° 25′   4.7 total ?

50) 214

	4.28	.6314
	4.23	.6263
comp	1.3	9.8861 - 10
		1.1438

13.9 Webers

7° 25   ) 9.1108

4.5554

1.1438

$\bar{3}$.4116 = Constant

4.7?	.6721
13.9	1.1438
	1.8159

65.4 Volts ?

June 12 a.m.

Tried the resistance coils to see how long ~~it took~~ they required in cooling

2268 Rev

15 sec	136
20 "	135
20 "	134
20 "	137
20 sec	132
1 min	131

Test time required in cooling

268 revs

30	134
25	133
25	132

about every 20 sec. .01 Ohm to be added to the resistance of the

140	
139	
138	
137	30
136	15
135	20
134	20
133	25
132	45
131	

268 revs

195 L

after 50 secs 135 + 3.5

Total 5.05

60

50) 195

5.9
4.23
1.33

.5911
.6232
9.8761 - 10
1.0924
5.5 .7223
60 1.7.37

12.3 Webers

62,1 Volts
probably 64 [illegible]
[illegible]

19.0192
4.5096
1.0904
2.4192 Constant

 June 12 ~~[illegible]~~ 1.25 P.M.

268 revs ~~[illegible]~~ 4 Daniells gave 46 L
45 R

Perhaps this was so this morning
and altered all my results
and made the Constant of the
Dynamometer higher than before.

~~4 cells~~ Standard 200 L
195 R

No 3 190 R
Fiducial changed 5 L

Again
Standard 196 L
198 R 196

No. 3	194 R	192
No. 2	191 R	189 L
No. 1	191 R	189 L
		766

.8642
.2923
.5919 3.91 Daniells
.0374
1.09 .6293 4.26

4 Daniells June 12 50 L −
268 revs 50 R +

New machine on its own
field

200 over 1.34 ohm
3/10 sec.
5° 49′ 1.33
5° 45′

	4	.6021
	4.26	.6293
amps	1.33	9.8761
	1.1075	12.8

5° 49′

9.0058
[illegible]
1.1075
3.4954 Constant

268 rev 182 L over 1,34 Ohms

4° 44'

50 | 182

	3.64	.5611
	4.26	.6294
comp	1.33	9.8761
		1,0666	11.5

4° 44

8,9165
4.4582
1.0666
2.3916

268 rev 145 L Field brought up 1.32

145 / 2,9

3° 4'

Not brought up 143

2° 59'

	2.9	.4624
	4.26	.6294
comp	1.32	9.8794
		.9716	9.37

2° 59

8.7163
4.3581
.9716
.3865

268 revs

117 over 1.32

2°

(117	
2.34	.3692
4.26	.6294
1.3	9.8861
	.8847

7.67

(8.5428
4.2714
8847
2.3867

268 revs

103 L

8.2 ohms

1° 37'

Took out five Ohms and put back

93 L

1° 19'

(103	
2.06	3139
4.26	6294
1.3	9.5861
	.8294

6.75 Webers

(8.6504
4.3252
8294
.3958

8.3

.8294
.9191
1.7485
56 Volts

14 L   50 (14

.121

.28 $\bar{1}.4472$
4.26 $\bar{1}.6294$
1.3   9.8861
     $\bar{1}.9627$

.91 Water

(7.5429
3.7714
$\bar{1}.9627$
$\bar{1}.8087$

NG

250 R.   1.37

268.800   9° 14'

Total 3.95 Ohms.

5   .6990
4.26   .6294
1.37   9.8633
     .1917   15.5
3.95   .5966
     1.7883   61.4

(9.2053
4.6026
1.1917
$\bar{2}.4109$

198 268 ribs

5.1 Total

5° 38'

5 | 198
3.96
4.26
comp. 1.35

.5977
.6294
9.8677
1.0968

12.5 Wides

5° 38

8.9919
4.4959
1.0968
2.3991

5.1 1.0968
.7076
1.8044

63.7 Volts

268 ribs 150

6.14 Total

3° 30'

3 .4771
4.26 .6294
comp 1.33 .8761
6.14 .9826 9.61
.7882 59 Volts
1.7708

3° 30

2 | 8.7856
4.3928
.9826
2.4102

253 4 Daniells 50 L
51 R

268 revs

153

6.1 Total

3° 22'

$\frac{1}{2}$ 153°
3.06 .4857
4.26 .6294
Comp 1.33 9.8761 .5055
.9912 .98 Weber

3° 22 8.7688
4.3844
9.912
$\bar{1}$.3932

.9912
2.1 .7853
1.7765 59.7 Volts

260 revs 254

124

2° 3' 7.1

50 / 124
2.48

.3945
.5055
.9000 7.94

2° 3

8.5535
4.3767
.5000
$\bar{1}$.3767

9000
7.1 .8513
1.7513
56.4 Volts

4.3767 Suppose
$\bar{1}$.4000
.7767 7.53

258

Gramme on field

268 revs 2° 30′ on 3.32 Ohms

Total 24.6 Ohms

98 L

(8.6396
4.3198
2.4000
.9199 8.3 Webers

(.98
1.96 .2923
4.26 .6294
comp 3.32 9.4989 .1283
.4106 2.57 Webers
24.6 .3909
.8015 63.3 Volts

265 revs ~~50 L on 3.32 Ohms~~ 259

2° 14′ No change in Gramme except from heating

50 L 3.32

Total 45.3 ohms

.1283 . 1.28 Weber
.6561
45.3 .7844 60.9

2° 14′ 2 (8.5907
4.2953
2.4000
.8953 7.86 Webers

260

269000 6° 30' Gramme

55 L on New Machine

|9.0538
4.5269
2.4000
1.1269 13.3

268000 9° 7' 261

58

|9.1998
4.5999
2.4000
1.1999 15.8 inches

 June 12

15^0 Gramme

268 revs

60 New machine

15^0

(9.4130

4.7065
$\bar{2}$.9000
1.3065   20.2

June 12 48 = 4 Daniells

52	first speed	268 revs
70		400
100		500
137		731 rev
169		1010
210		1380

on 3.3

Gramme $3^0, 1'$

Total 46.3

(8.7212

4.3606
$\bar{2}$.4000
.9666   4.20 Webers in field

 June 12

Comp 48 8.3198 -10

4.23 .6263

Comp 3.3 9.4815 -10

2.4276

268 revs.

52 1.7160

.1336

1.36 Webers 1.6646

46.3 1.8072

64.1 Volts

2.4276

1.6646

340 revs

0 0922

70 .8451

86.6 Volts .9373

---

520 revs 123. Volts 2.0922

---

731 revs .0922

137 2.1367

169 Volts 2.2289

1010 revolutions June 12

.0922

169 2.2279

21.0 Volts 2.3201

192 Daniells .0374

2.2837

1380 revs .0922

210 2.3222

260 Volts 2.4144

I take for granted that the resistance of the whole circuit increases proportionally to the resistance around the galvanometer which must be nearly the case.

 June 13

4 Daniells 50

The machine on the pulley marked 500 only ran 320 50 Ohms total
belt slipped as per measurement

50 / 16.5 over 1.29

3.3	.5185	Total 6.2
4.23	.6332	
Comp 1.29	9.8894	
	1.0411	.11 Webers
6.2	.7924	
	1.8335	68.1 Volts
	1.0411	
44.5	1.6484	
33,300 ft. lbs.	4.5230	

~~423 revo~~

Belt probably slipped

220 423 revo
215 over 1.3
6.3 Ohms total

50 / 215

4.3	.6335	
4.23	.6[illegible]	
Comp 1.27	.8962	
	1.1560	1.5
6.3	.7993	
	1.9553	90.2 Volts
	1.[illegible]	
44.5	1.6484	
	4.7597	
57,500 ft. lbs.		

~~at~~ June 12

255 on 1.32

6.35 Total

5/255

5.1

4.23

Comp 1.29

.7076

.6263

9.8894

1.2233

6.35 .8028

2.0261

1.2233

44.5 1.6484

4.8978

16.7 Webers

106: Volts

→ 5

33.000 179.000 ft. lbs.

4.8978

4 5185

0 3793

2.4 H.P.

Jumps the three breaks in the switch

500 revolutions June 12

240

1.33

 June 12

Page 137 Lamp .77 on Gram

75	1.8751
105	1.0212
	.8539
7.14	1.8865
.77	.9674
	.9674
9.2 8 lamps	.9674
	1.9348

E. M. F. for 100 Ohm lamps.

$E_1^2 : E_2^2 :: R_1 : R_2$

$E_1^2 : E_2^2 :: R_1^2 : R_2^2$

$E_1 = 75$ 75

$E_2 = X$

$R_1 = .77$

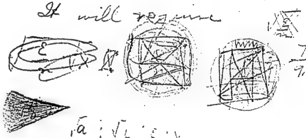
$R_2 = 100$

1.8751
1.8751
~~.1135~~
.1135
~~6.1021~~
5.8537
2.

 June 12 ~~8 lamps~~ Resistance of machine = 0 n lamps each having a Ohms resistance require an E. M. F of E how large an ~~resistance~~ E. M. F. will ~~8~~ lamps of b Ohms require in circuit

$\frac{E}{n}$ = E. M. F on one lamp of a resistance

It will require



75
9.28

a : √b : E : x

a : b : E² : x²

a = .77

~~3.9289~~

~~1.8644~~ 75.2

1.9644

1.8751
1.8751
2.
.1135
5.8637
.9674
4.8963
.9674
3.9289

June 12

$a : b :: E^2 : x^2$

$a = .77$

$b = 100$

$E = \frac{75}{9.28}$

10.1135 −10
2.
1.8751
1.8751
9.0325 −10
9.0325 −10

$2 \overline{)\,3.9287}$

1.9643

~~Volts~~

92.1 Volts

June 13

Standard 213 L
210 L 213 R
Zn. and Cu. solutions well saturated

No. 3 199 L 203 R

No. 2 193 L 195
193 L 194 L
195 R

No. 7 207 L
210 R

Test of Gramme regulator having 30 ohm resistance.
1 cell Daniells 105 R

$\frac{13}{100}$ or .33 Ohm

on regulator
135

 1 cell Fuller June 13

$\frac{22}{100}$ on .66

125 on regulator

2 cells

250 255 on regulator

35
30 on .66 Ohms

19 on .33 Ohms

11 L .66
25 L

Fiducial 4 R

June 13
Standard 99 L

99 R

2 cells

on .33 Ohms

15 R

on Regulator 270 very fast

on .66 Ohms 29 & 30

on Regulator
255

1 cell

.33 10 R

135 L

2

276

June 13

.66

U = 20

Regulator 17.5

$\frac{15}{99} \times 1.09 \times 44.5 \times 3$

3

133.5 2.1253

1.09 .0374

15 1.1761

Comp 99 8.0044

1.3432

22.0 ft lbs 270 2.4314

15 8.8239

406 ft. lbs 2.6085

4.5185

2.6085

81 per H.P. 1.9100

255 June 13 .4065 277

1.09

Comp 99

44.5

Comp .66

On .33 ohms E. M. F

$\frac{15}{99} \times \frac{1}{.33} \times 1.09$

15 1.1761

1.09 0.0374

Comp 99 8.0044 − 10

Comp .33 10.4815 − 10

.5 Webers 7.6994

1.6990

1.5185

1.1761

8.0044

1.1805

.15 Volt

2.9073

44.5 1.6485

0.5558

3.59 ft lbs

on .33

0.5558 June 13

.270 2.4314

comp 15 8.8239

1.8111

64.7 ft. lbs. 33000

4.5185

1.8111

2.7074 33000

510 per H. P.

.66

Regulator stopped

51

Regulator running 30

Regulator running 255

Regulator stopped ~~190~~ ~~255~~

190

June 13

$\frac{190}{51} \times .66$

2.2788

$\bar{1}$.8195

8.2924

.3907

2.46 Ohms

0 Wheatstone 3.2 Ohms

Varies a good deal

Say 3 ohms

$\bar{1}$.6994

$\bar{1}$.6994

3 .4771

44.5 1.6435

1.5294

33.8 ft lbs in the resistance

64.7

33.8

30.9 ft lbs in motion

June 13

33,000 4.5185
~~30.9~~ 30.9 1.4900
3.0285
1067 per H.P.

$\frac{29}{99} \times 1.09 \times \frac{1}{.66}$ = Webers

1.4624
8.0044 − 10
.0374
10.1805 − 10
9.6851 4.84 Webers
$\bar{1}$.6851
.66 $\bar{1}$.8195
44.5 1.6484
.8381 6.89 ft lbs

255 .8381
com 29 2.4065
8.5376 − 10
1.7822

60.5 foot lbs used

---

1 Weber current on a 100 Ohm lamp

---

say 30 ft lbs used in resistance [illegible]

$1^2 \times x \times 44.5 = 30$ ft lbs.

$x = \frac{30}{44.5}$ = about $\frac{5}{7}$ [illegible]

so a 3/4 of an Ohm [illegible] ought to do the business

Since 3 Ohm [illegible] 1/2 Weber current

Hand turning a .14 machine large fly wheel, wood pulley –

6660 ft lbs. outside.

4

33.

$$\begin{array}{r} 22 \\ 13 \\ \hline 66 \end{array}$$

22 6

28

5000.

1000

9000

$$\begin{array}{r} 13. \\ 6 \\ \hline 19. \end{array}$$

$$\begin{array}{r} 25 \\ 13 \\ \hline 75 \\ 25 \\ \hline 325 \end{array}$$

18,

9

1 2 3 4 5 6 7 9
4 9 3 8 2 9 1 5

10

20/80 1/4

20/80 1/4

1
2
3
4
5
6
7
8
9

4

43
43
129
172
1849
44
7396
7396
81,356

12/ 81,356

15/ 81356 (5423
75
63
60
35
30
56
45
11

10.
25
100.
60.

10
30
50

Menlo Park Notebook #9 [N-78-12-15.1]

This notebook covers the period December 1878-March 1879. All of the entries are by Edison, Charles Batchelor, and Francis Upton, with the exception of a few drawings by John Kruesi. The name of John Ott occasionally appears as a witness. Most of the material relates to experiments on electric lighting. There are drawings of lamps, including vacuum experiments; drawings of devices for making and testing wire spiral filaments; notes on platinum and platinum-iridium wire; notes and drawings of generators; calculations of system costs, including comparisons to gas lighting costs; and drawings and calculations about meters, including some labeled "Sprague's Exhibit Edison's Early Sketch No. [2-4] Jan. 12th 1886." There are also drawings of the electric pen and the phonograph. The book contains 241 numbered pages followed by 30 unnumbered pages.

No 9

Edison Laboratory Note Book No. 9

Page 1

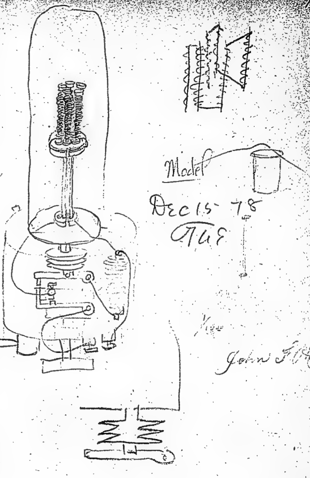
See Edison Patents:

214,636	227,227
214,637	227,228
218,866	227,229

May 1, 1896

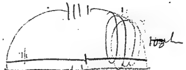
= 240-

= 35 = 3

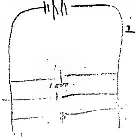


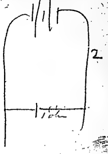
Pages 3 to 14."Dyn. Sketches & Notes". (Unimportant)

Dynamo mac Dec 15/76
TAE

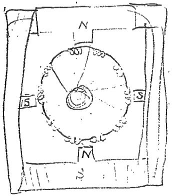


100; of 1 ohm each. 100 ohms

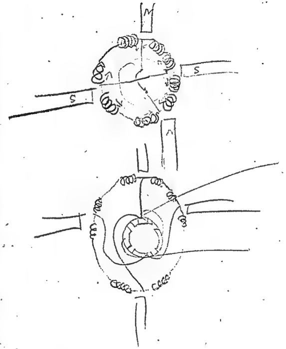




Dynamo Mac Dec 15 78
30 TAE

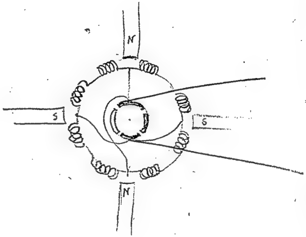


Dynamo Mach Dec 15/78
TAE



Dynamo Mach Dec 15/78

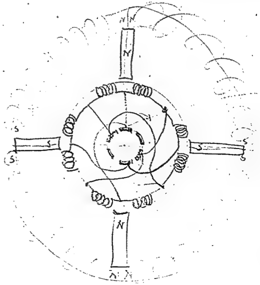
TAE

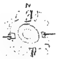


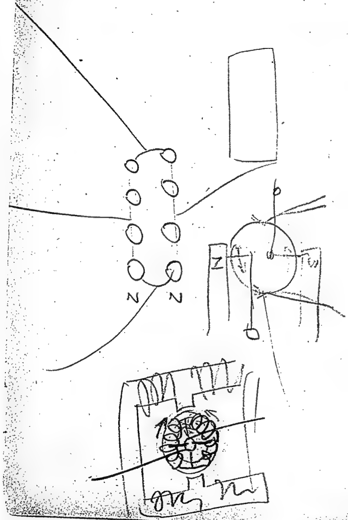
Dec 15/78

Dynamo Mac

TAE



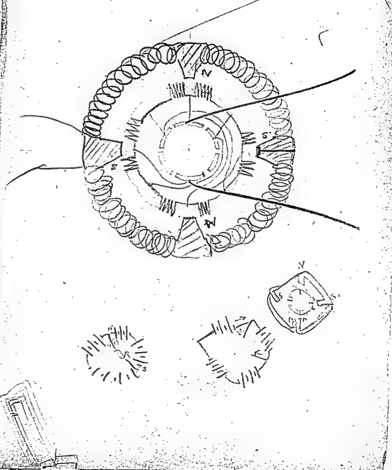




Dec 15 1878

Dynamo Mac

TAE



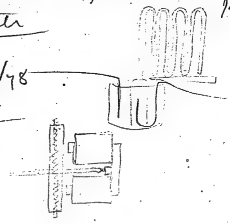
"Sprague's Exhibit Edison's early sketch, No 2."

Jan. 12th 1886

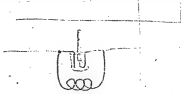
Meter

Dec 15/78

TAE



I propose to shunt a small quantity of the current through a decomposing cell of Hg or Cu & weight the deposit every month to determine



the current consumed — I could use the gas evolved by electrolysis but deposit is better as there is no polarization.

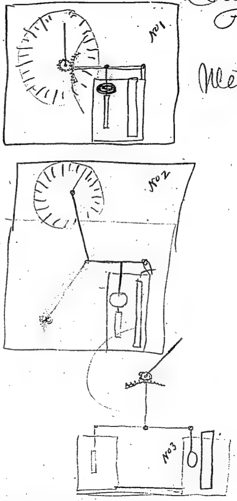
TAE

Spragues Exhibit Edisons
early sketch No. 3" Jan 12, 1886.

Dec 15 /78

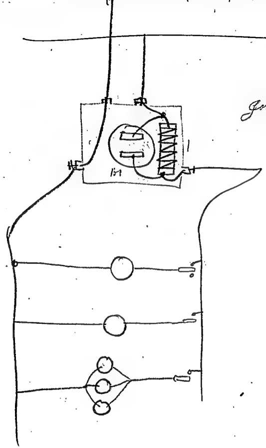
TAE

Meter.

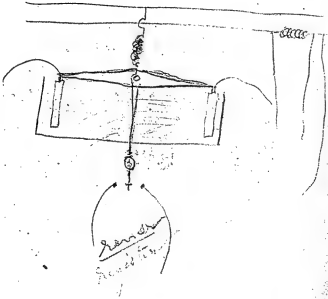


18

Sprague's Exhibit Edison. 19
early sketch, No 4.



John F. Ott



Edison Laboratory Note Book No. 9

Page 21

Notes on Platinum & other metals & Metallic Oxides

See Edison Patents:

214,636	224,329
227,228	218,866
227,227	227,229

20

[illegible] Note Book No.

Page 21

Note on Platinum [illegible]

See Edison Patents:

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

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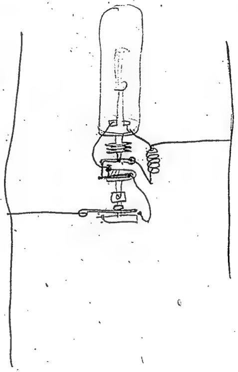
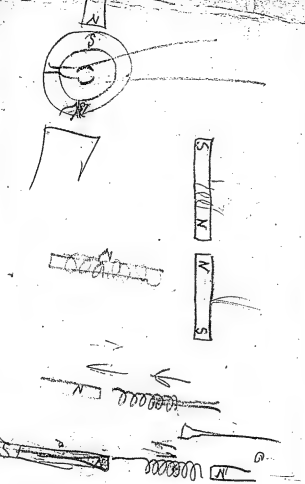
21

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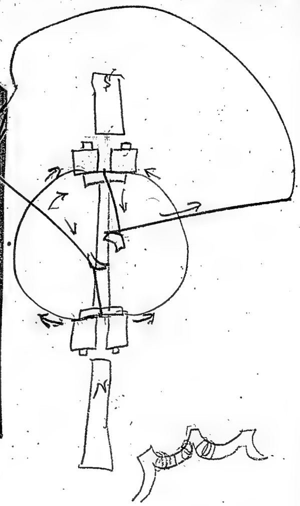
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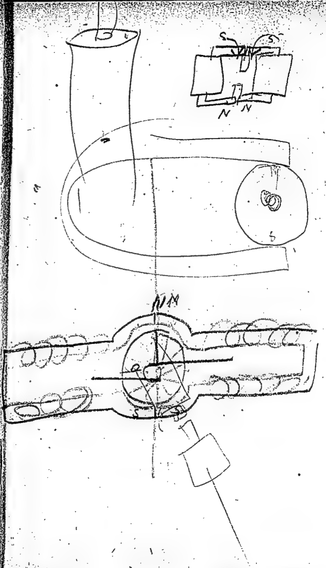
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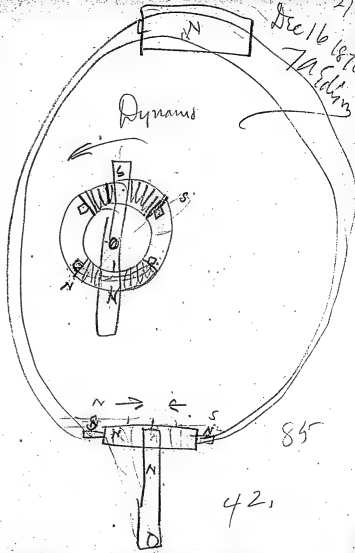
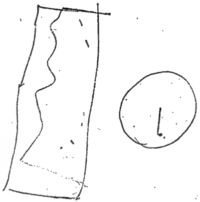
Dec 16 1878
T A Edison

Dynamo



85

42,



6) 320

64
5
320

inch

64, 80, 960 —
480
320

100,

200.

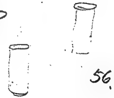
2 hp —

Cop rod $\frac{1}{4}$ inch dia 30 inch length
Res $\frac{1}{2500}$ of an ohm. temp 1000

4

~~6046~~
~~3023~~
~~$2\frac{1}{2}$) 6046~~
~~1416~~

~~$\frac{1}{2500}$~~
~~1416~~
~~2~~
~~2832~~



56

38

4. 8 16 32 64 —

5 10 20 40 80 2 1

8

12
80
960

3/4. 3

3/8

1/2 1 1/2

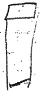
4 8

1/2 1

4/4

7/8

3/4.



1

2

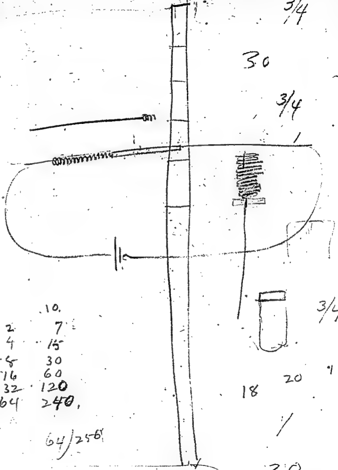
4 200 27

23
$11\frac{1}{2}$

2

5.4
1.0

27



3/4

30

3/4

1

3/4

	10
2	7
4	15
8	30
16	60
32	120
64	240

64)256

18 20

1

20

64	64
4	3
256	192

3 2
2 2

$\frac{1}{2000}$ $\frac{1}{10,000}$

$\frac{1}{4}$ inch 2 miles is .2.

1/2 .50

1 0250

2 0062.

4 0087.

8 1 3/4.

62 1/2
4
248

1. 500 50.

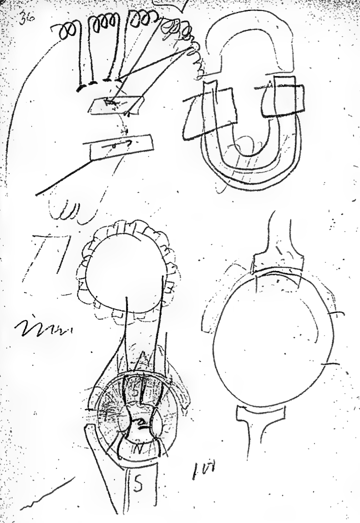
2.

Railway

Rain

Boston

Boston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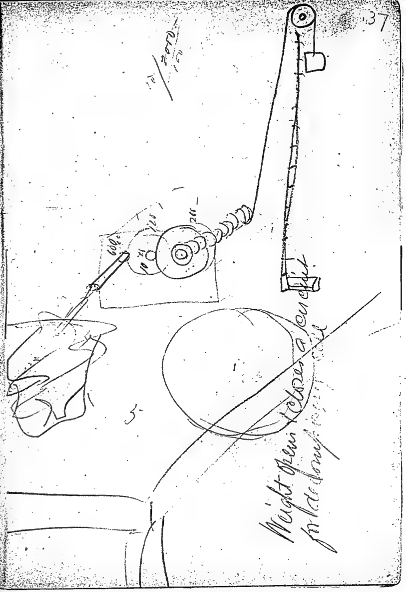
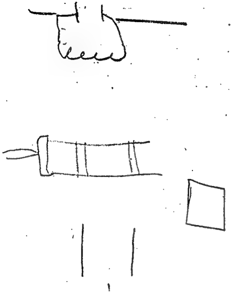

Weight opens & closes a circuit
for telephone



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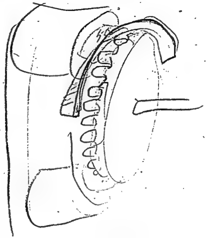
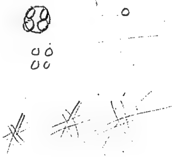
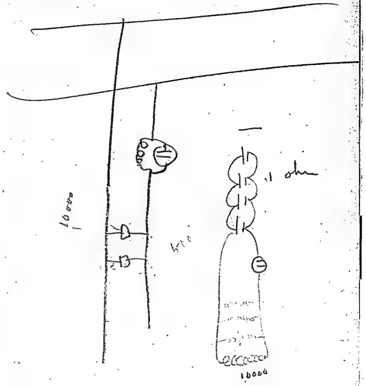






$$C = \frac{E}{R+r} \qquad C = \frac{E}{5000+1}$$

$$C = \frac{E}{2500+1}$$

$$4096\overline{)1352000}(330$$

12288

123200

12288

320

$$C = \frac{4}{10000 + 4}$$

$$C = \frac{1}{2501}$$

$$\begin{array}{r} 54 \\ 7 \\ \hline 378 \end{array}$$

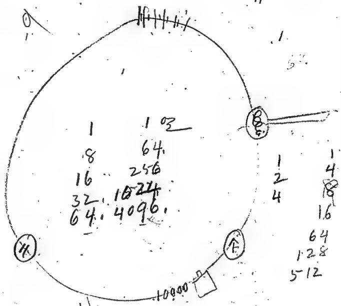
$$\begin{array}{r} 65 \\ 65 \\ \hline 325 \\ 390 \\ \hline 4225 \\ 4096 \\ \hline 129 \end{array}$$

4096 : 4225 :: 320 :

$$\begin{array}{r} 320 \\ \hline 84500 \\ 12675 \\ \hline 1352000 \end{array}$$

1 4096.

1 2 1. 64.



1 1
2 4
4 8
16
64
128
512

64
5
320.

$$C = \frac{E}{R + r} = \frac{1}{10000 + 1}$$

$$C = \frac{2}{10000 + 2}$$

64) 320

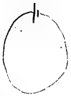
65) 330

```
   66
   66
  ----
  396
 396
 ----
 4356
```

4225 : 4356 :: 330 :

```
       .330
     ------
     130680
    130680
    ------
4225)937680 0  (340
     12675
     -----
     16998
         0
```


1 ohm 1.03

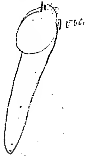


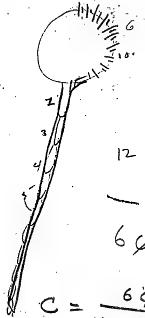
$C = \frac{E}{R + r}$

1 ohm 1.03

10,

40.





1 emf

12 12 cells.

6 ¢

$C = \frac{6 ¢}{1 \text{ ohm } + 6 ¢}$

$C = \frac{6 ¢}{1 \text{ ohm } + 6 ¢}$

$$\frac{80}{100000 + 80}$$

$$\frac{80}{10080} -$$

$$\frac{2}{252} \quad \frac{1}{126}$$

$$\frac{1}{126}$$

80

80

4356 : 6400 :: 340 :

340

256

192

4356) 2176 anw (500

~~174224~~

80

2780

974

160

$$\frac{64}{6400}$$ 6.2

6

$$\frac{12}{1000} \quad \frac{3}{250}$$

16

$$\frac{2}{125} \quad \frac{1}{81}$$

$$\frac{1}{62}$$ 14 200, 2.800 16, 3

500, 3

72

20

66 15 330 66 1090

14 20 280.

1 1.4 80 1120 200,

14 70 14 70 980. 36,

72. 6 18 6 108 3

36, 40 6 240.

67

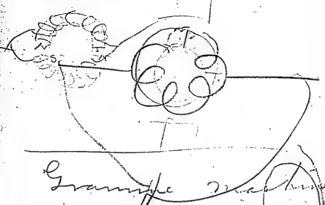
47.

7568960

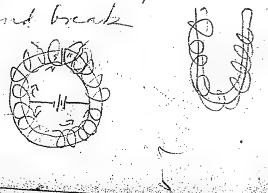
57 5 45 6 270 46 6 276 47 282

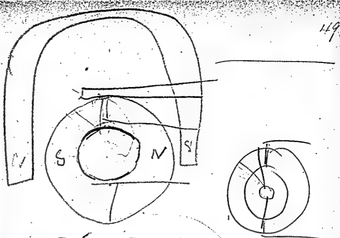
If a battery works against a Gramme

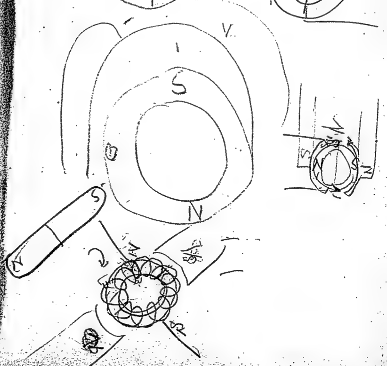
Question

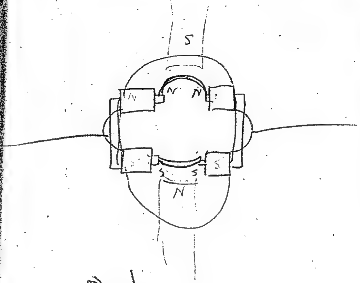


Gramme machine moves about the same How much power Hand break





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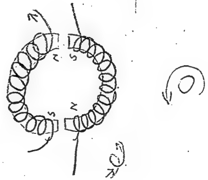
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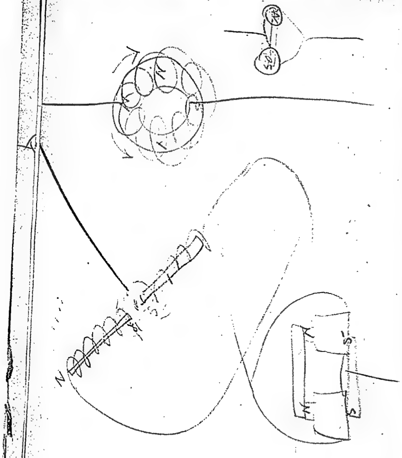
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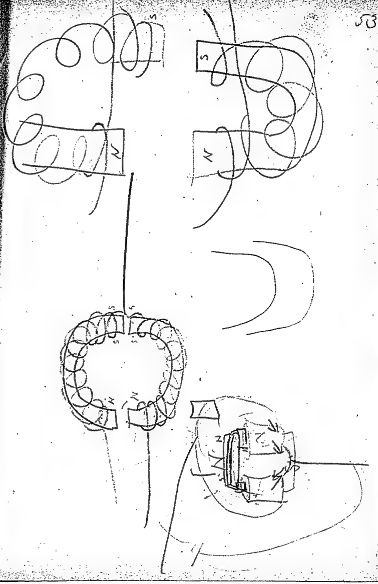
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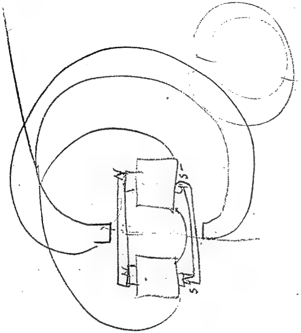

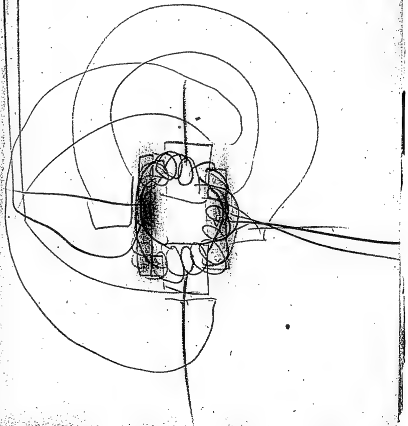

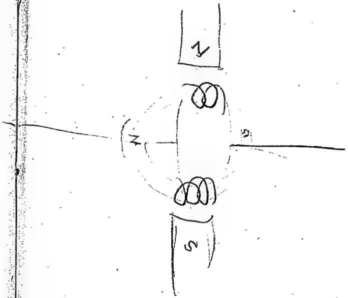
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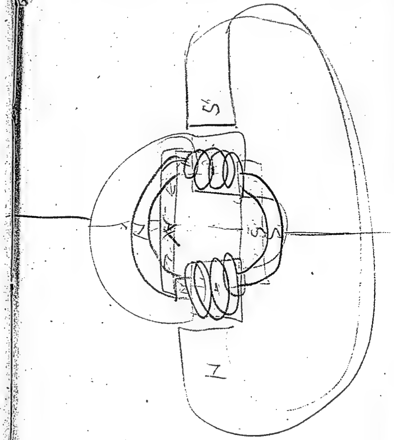
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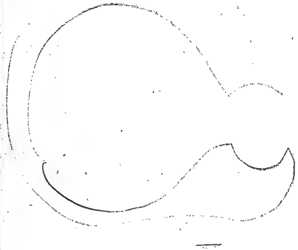


62

3. No 36 Wire

00.4 3 ft long

.300

3.14
.04

3.14
.004

3.14
.004

0.01256

r^2 3
3

.01256
.36

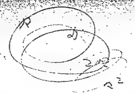
7536
3768

.45216

56

3.14
.004

.01256
36



63

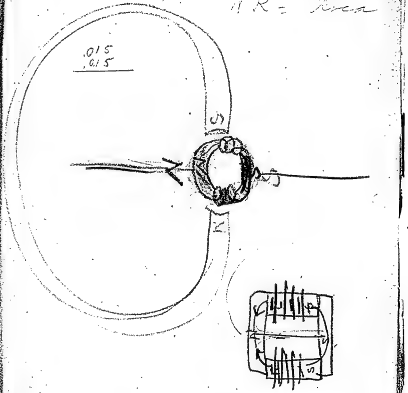
R

πr

πD = circ

πR^2 = Area

.015
.015



$\frac{1}{10}$

$\frac{3}{10}$ 3000°

$1\frac{1}{2}$ 4

$\frac{3}{2} \times \frac{10}{3} = 5$ Lamps

10 Lamps

Tried magnet

tried commutator

Six lamps all red heat from the 3 —

Six lamps $\frac{1}{4}$ in

$\frac{1}{2}$ Hp 3000° 7

$1\frac{1}{2}$ inches $1\frac{1}{2}$

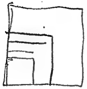
$\frac{1}{2}$ 3 Flames

$4\frac{1}{2}$ to 5 Burners to HP.

$\frac{3}{8} \cdot \frac{3}{32} = \frac{9}{256}$

8.

8 inches



$$\begin{array}{r} .015 \\ 8 \\ \hline .120 \\ .34 \\ \hline .36 \\ 9 \\ \hline .27 \end{array}$$

$\frac{3}{4} \quad \frac{3}{16}$

$$\begin{array}{r} 9 \\ \hline 684)\,9.0\,(14 \\ 64 \\ \hline 260 \\ 256 \\ \hline 4 \end{array}$$

$$\begin{array}{r} 256.)\,9.00\,(35 \\ 768 \\ \hline 1320 \end{array}$$

~~.035~~ →

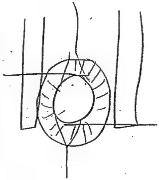
27

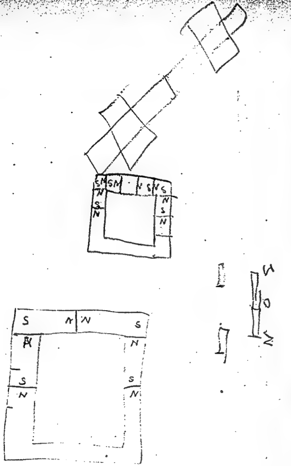
$$\begin{array}{r} .105 \\ .27 \\ \hline .375 \\ .27 \\ \hline .645 \\ .052 \\ \hline .697 \\ .84 \\ \hline 1.53 \end{array}$$

$\frac{7}{10}$ inch

$$\begin{array}{r} .14 \\ 6 \\ \hline .84 \end{array}$$

$$\begin{array}{r} .84 \\ .27 \\ .27 \\ \hline 1.38 \end{array}$$

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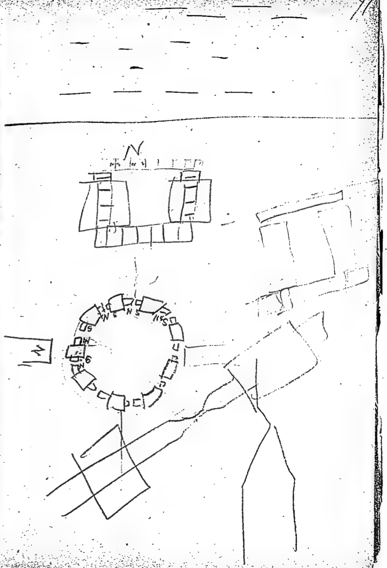
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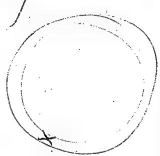

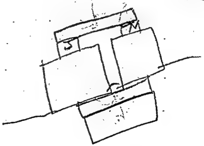

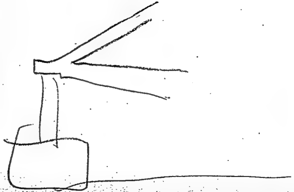

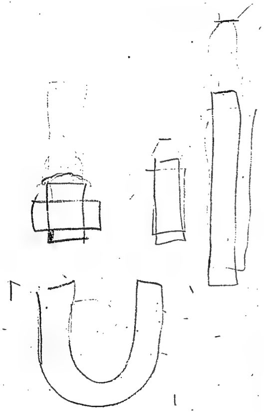

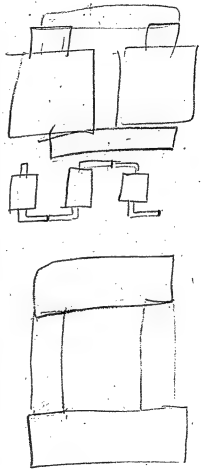

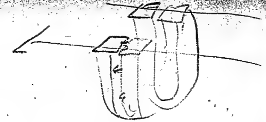

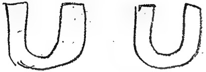

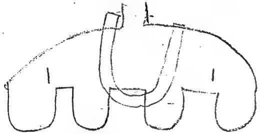

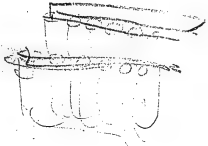

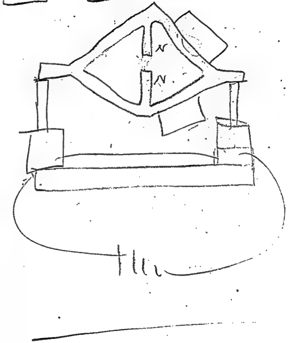
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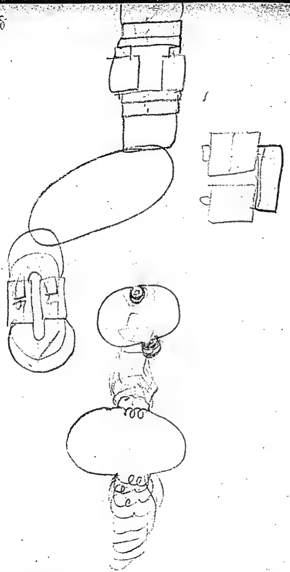

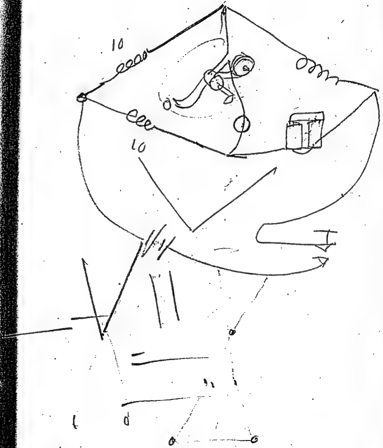
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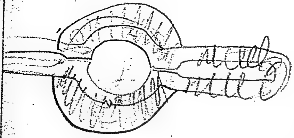

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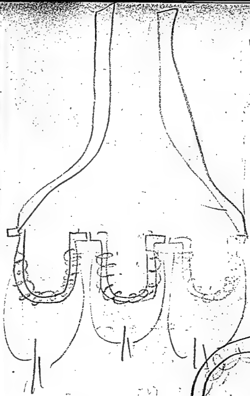

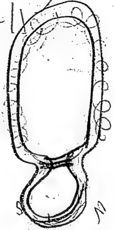

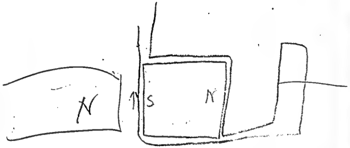
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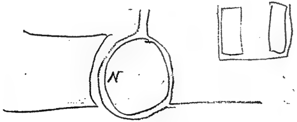
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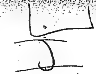

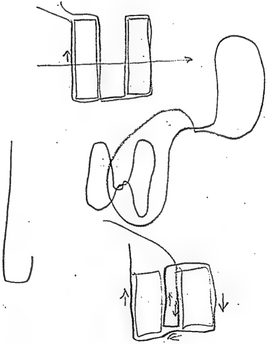

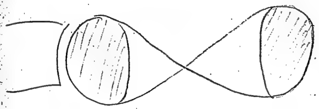

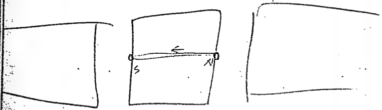
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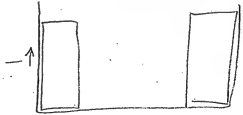
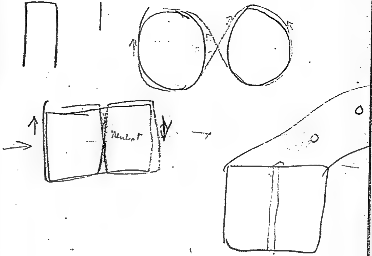
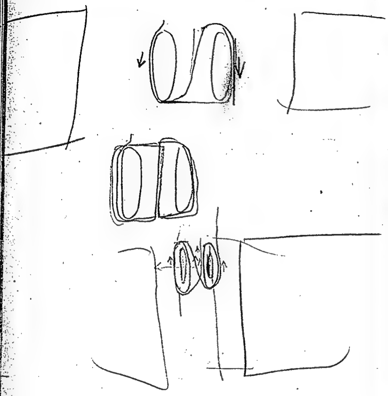
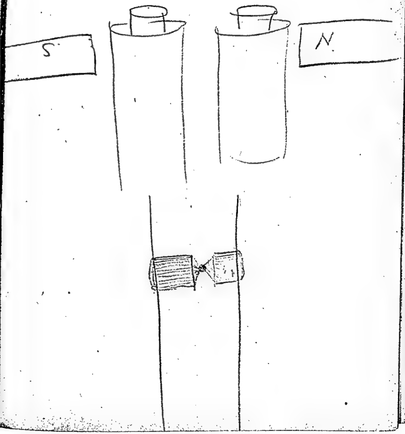



Neubat

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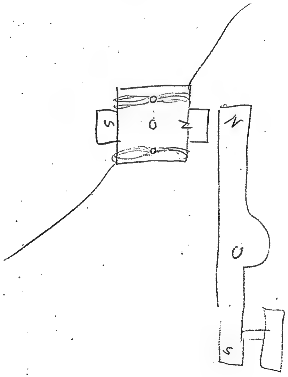
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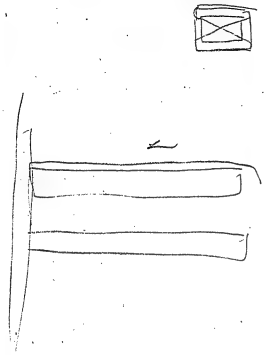

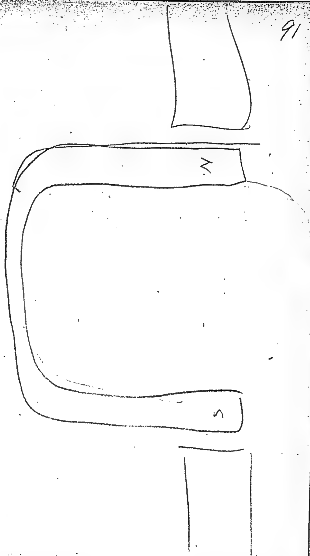

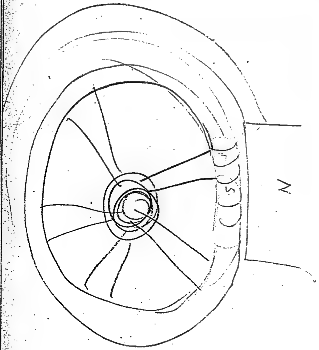
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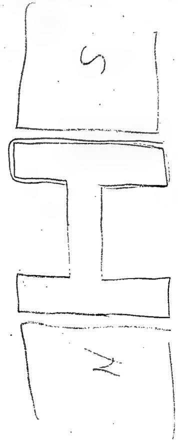
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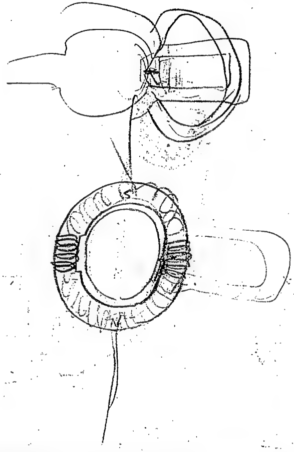
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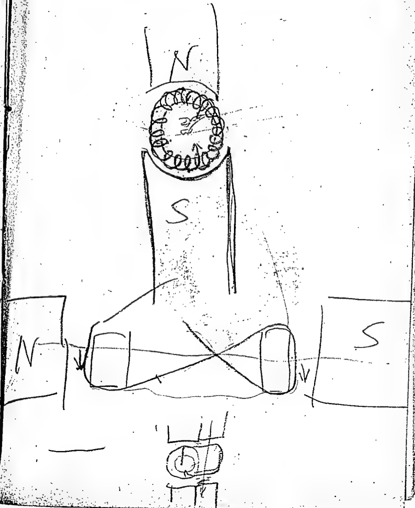
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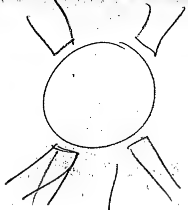
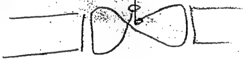
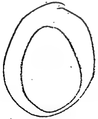
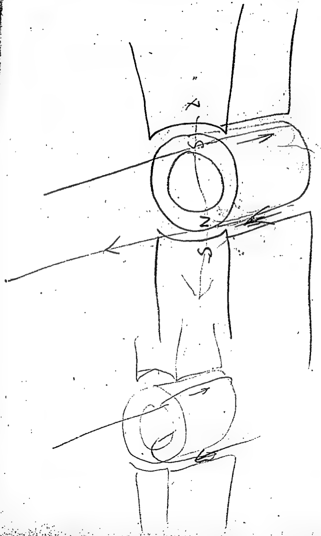
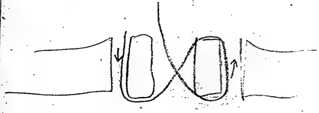
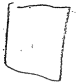


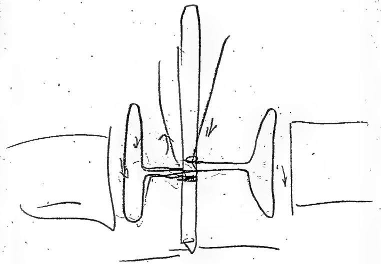


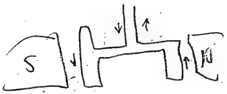



x
s
z
s





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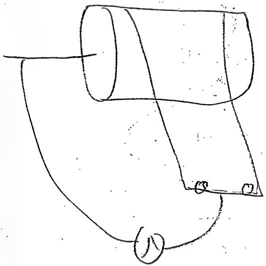
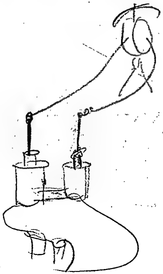
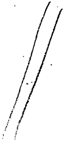
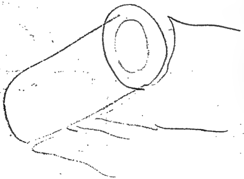
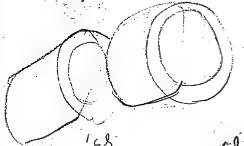
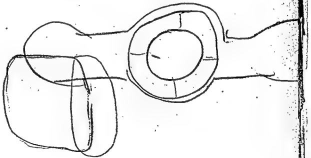


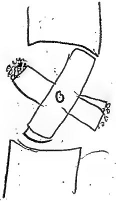


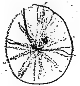


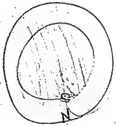


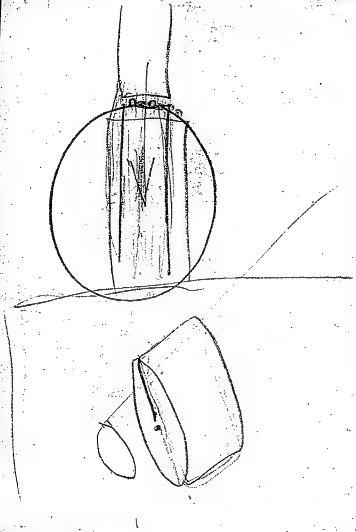


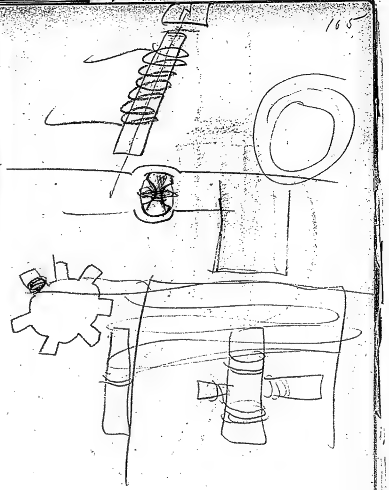


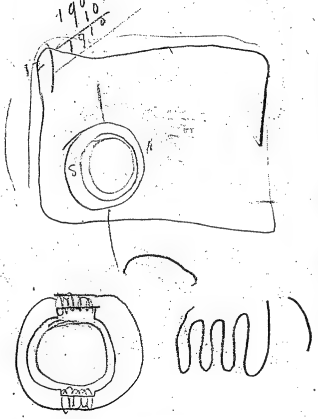




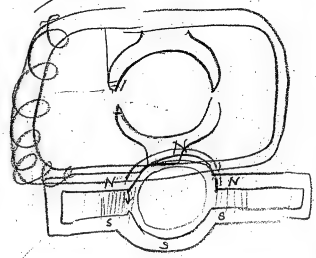


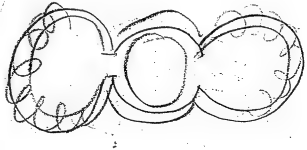




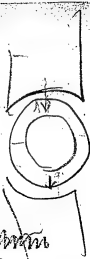


32/6 192 3/2





55
85
275
440
5



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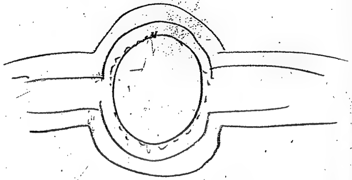


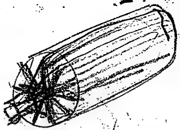
96

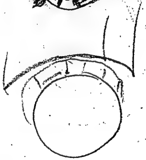
85

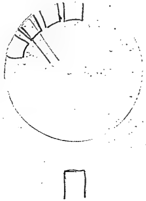
100. 100.

100. 600.

1 2







John Ott

Blackwalnut or better Cherry —

No 1

Edison Laboratory Note Book No. 9

Pages 111 to 126.

Incandescent Electric Light.

See Edison Patents:

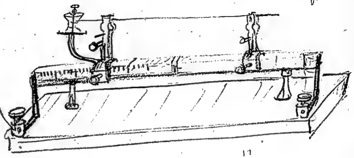
214,636	214,637
218,866	227,227
227,228	227,229

Smaller one. 2 feet long —

John Ott

Blackwalnut or better Cherry –

No 1

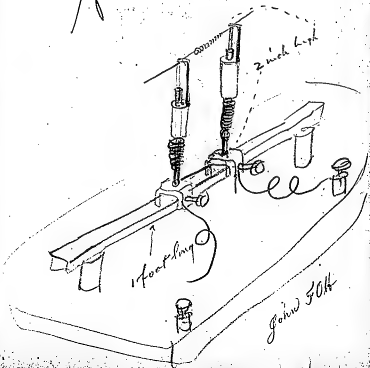


10 feet long.

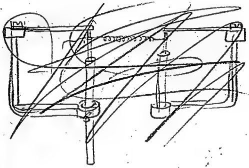
divided whole length into 1/16. 1/4 1/2 & 1 inch marks.

Smaller one. 2 feet long –

No 2



960
772
1920



772
1000
772000

960
772
1920
20

23.

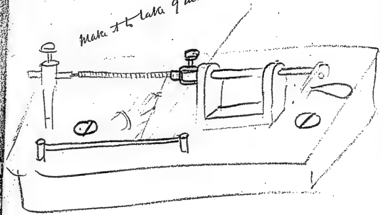
No 3

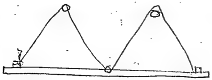
Jan 14 1879

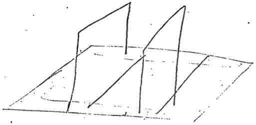
Mandrels with threads cut in to keep wire apart,

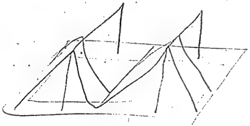
Chas Batchelor

Make it to take 9 inches

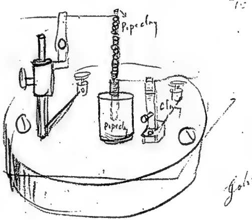






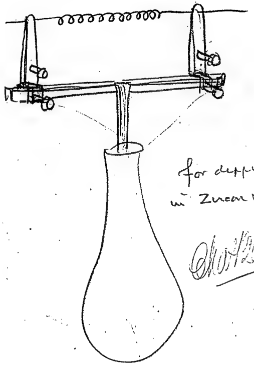


No 4



John F Ott

No 5 Jan 13th 1879



for dipping
in Zircon Solution,

Chas Batchelor

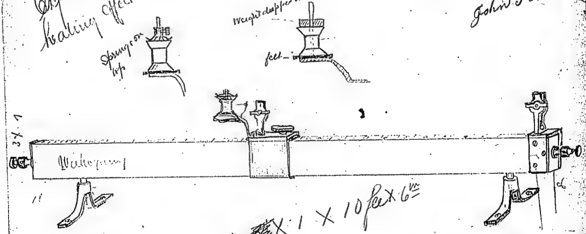
$1\frac{1}{2} \times \frac{5}{8} \times 2\text{ft } 4\text{in}$

Jan 9 1899

Chas Batchelor

John F Ott

Experimental Inst. for heating effects in wire

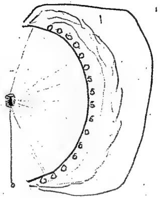


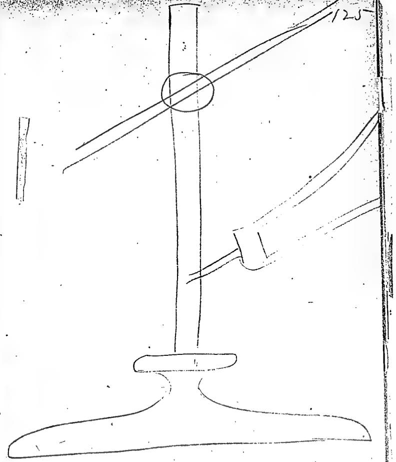
3 [illegible] x 1 x 10 feet x 6 in

Concentration of heat

Jan 9 1879

Chas Batchelor

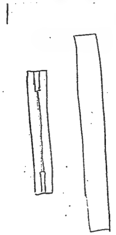


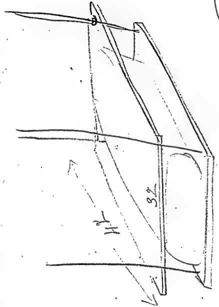


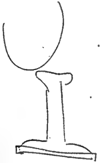
126

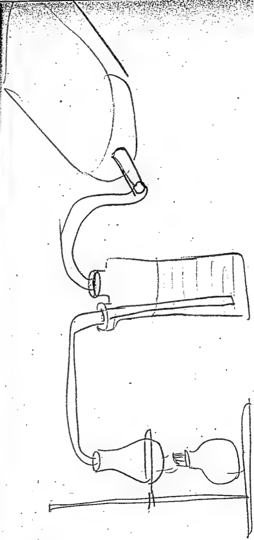
127

Pages 127 to 162. "Dynamo Sketches, &C."
(Unimportant)

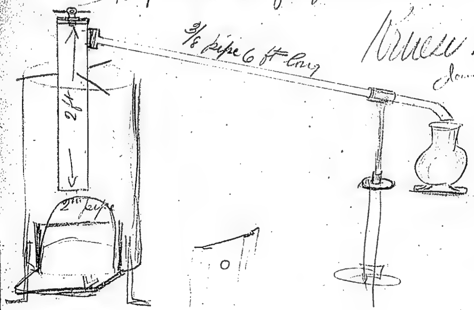




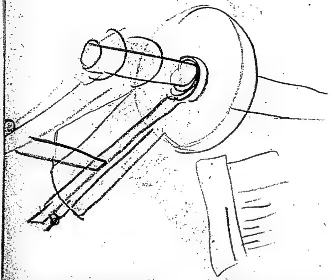


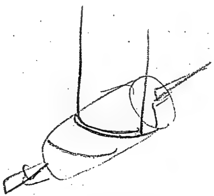


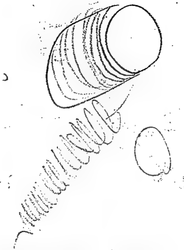
Plug to take out for pouring mercury in

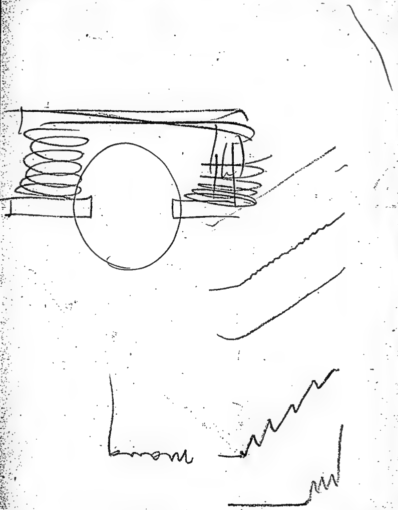


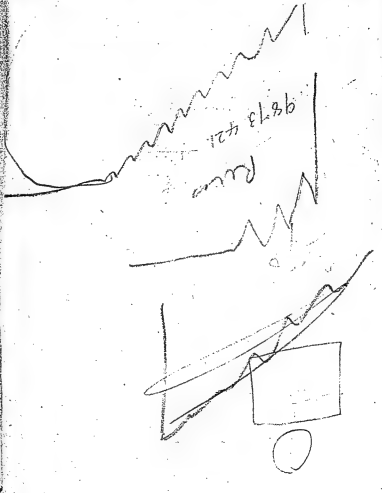
Kruesi Make
Jan 23d 1879





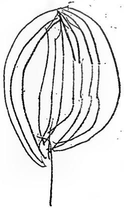


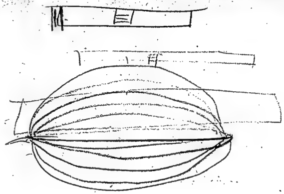




Wire 1 Ohm

~~Throw one unit of energy~~





$\frac{1}{10}$ $\frac{1}{10}$ $\frac{1}{10}$

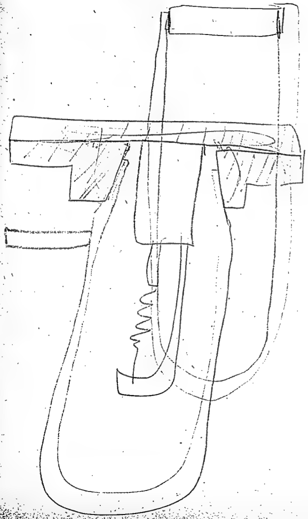
1 unit of energy

1 Unit of Energy

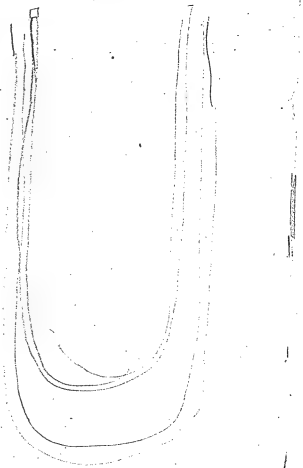
in 1 Ohm

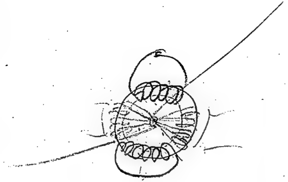
10 Ohms twisted $\frac{1}{10}$

138



139





New 10.2 mg 100 mms

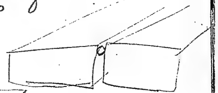
$$\frac{\overset{10.2}{1}}{31.103}\ \text{oz}$$

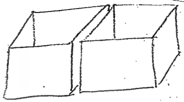
1.0086
4.5072
1 48 41

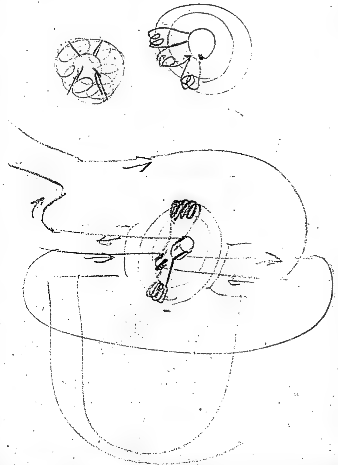
$$\frac{10.2}{31.003} \qquad \frac{1}{3000}$$

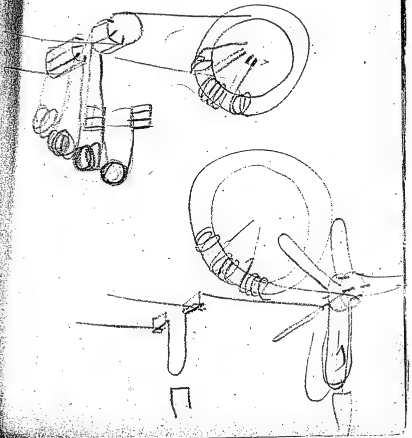
$$\frac{2230}{1000}\ \text{oz} = .02$$ cts [illegible]

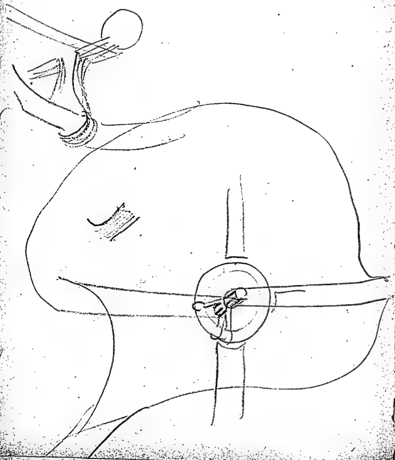
10.2

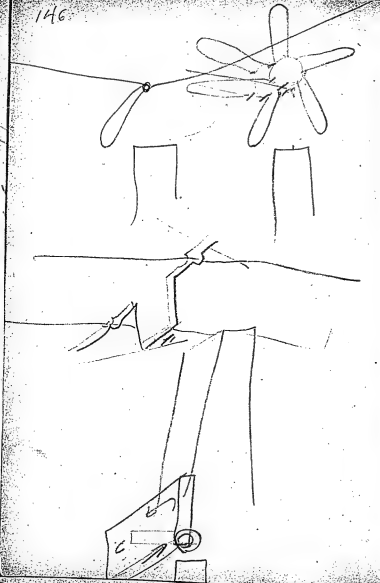


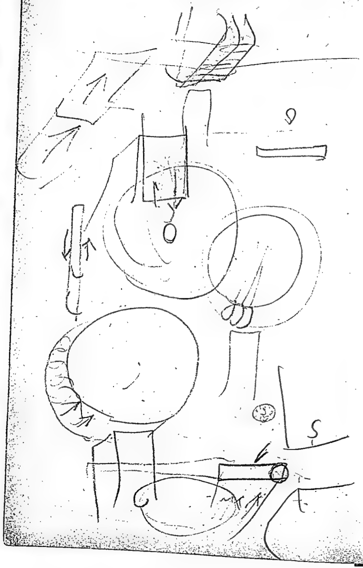


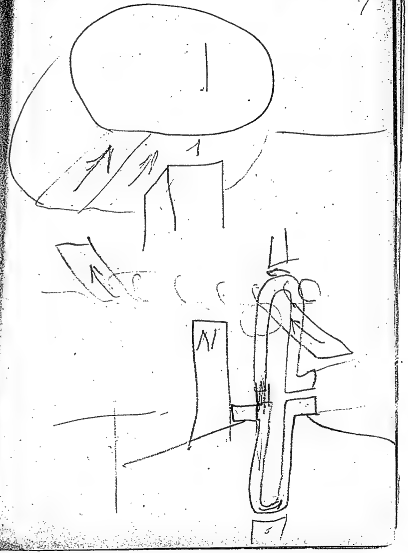


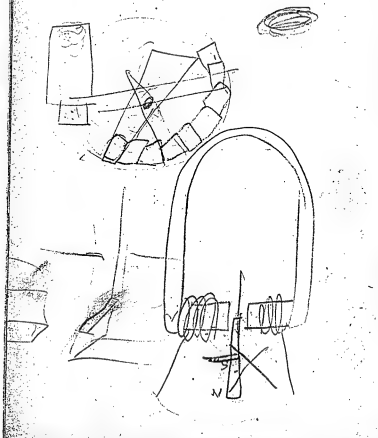


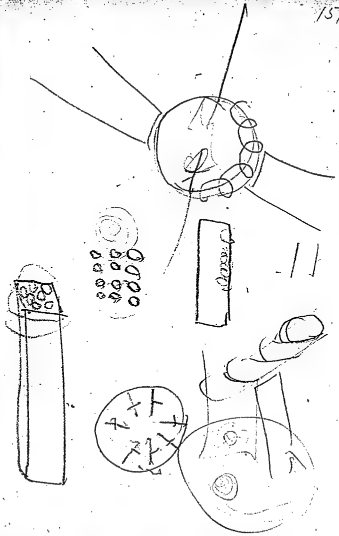


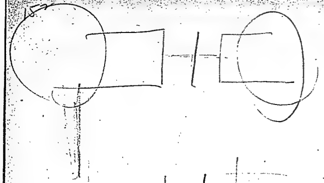


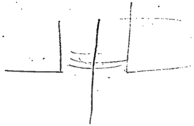


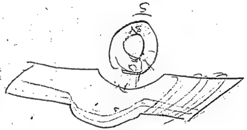


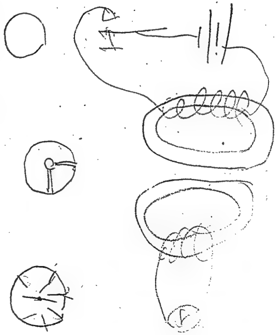


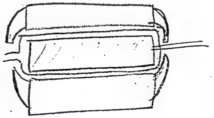


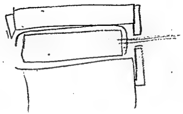


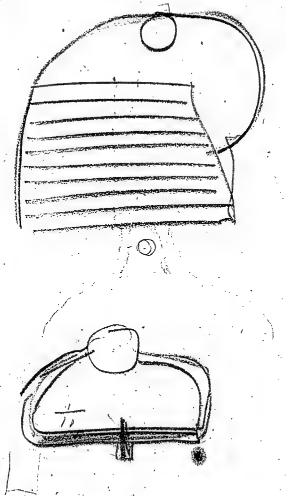


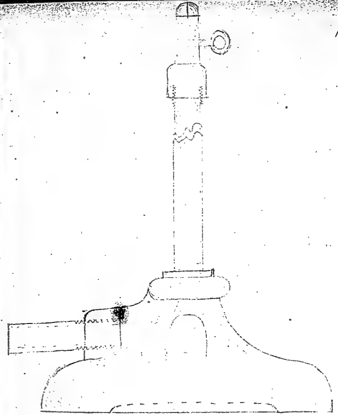


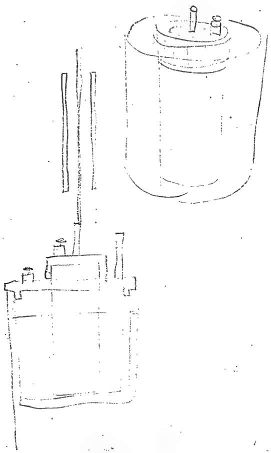


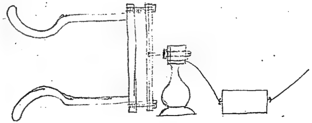












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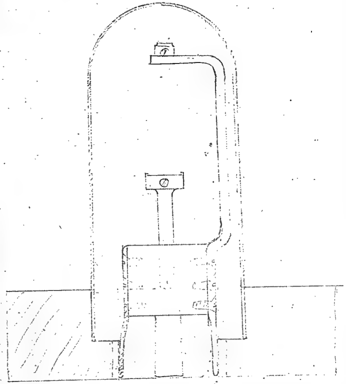
Febr. 10th 1879 Vacuum experiments for electric light. etc.



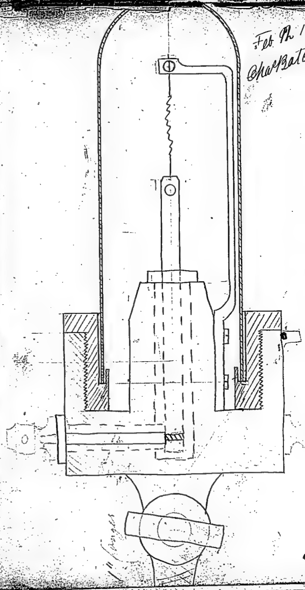
Chas Batchelor

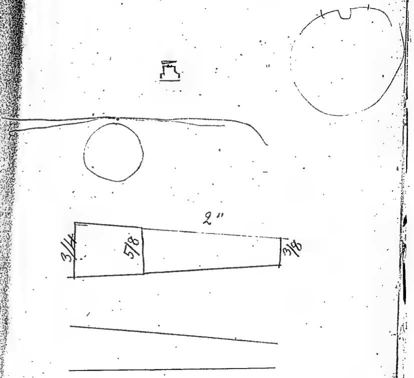
100

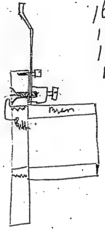
.005

Feb 9th 1879

Chas Batchelor



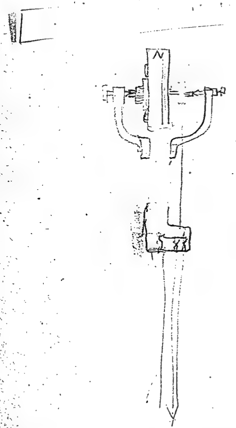

2"
3/4
5/8
3/8



16 Bindposts
16 Springs
1 Rubber plate
1 Brass bush

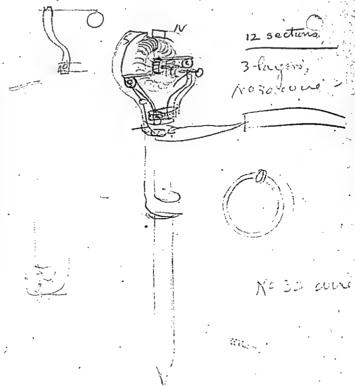
Edison's Magneto

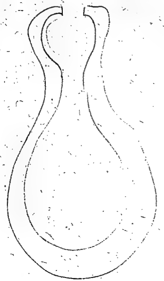
When making another machine fasten down the armature wire that runs in groove on shaft by a thin sleeve

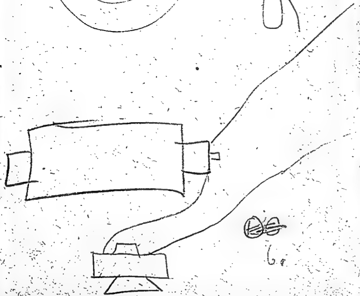


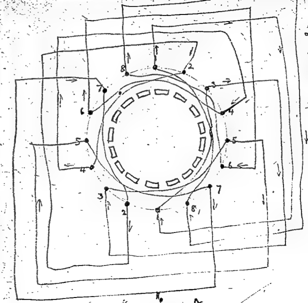
Feby-16 1879

T.A.E



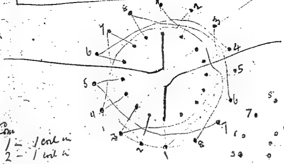




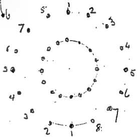


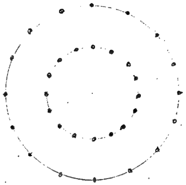
Feb 15 1879

Batchelor



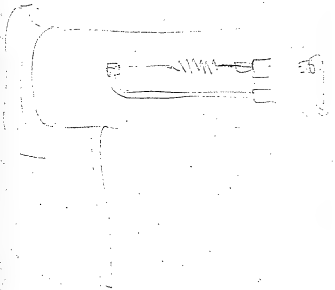
Con
1 = 1 coil in
2 – 1 coil in
3 [illegible]

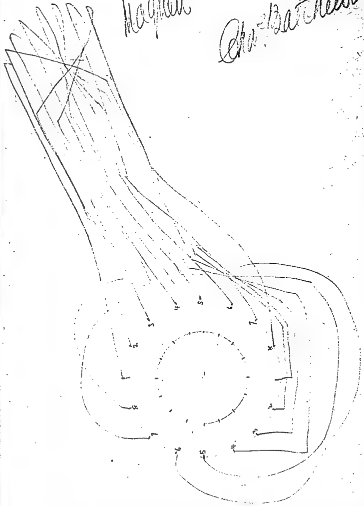


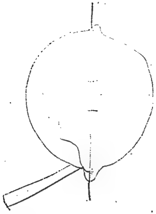


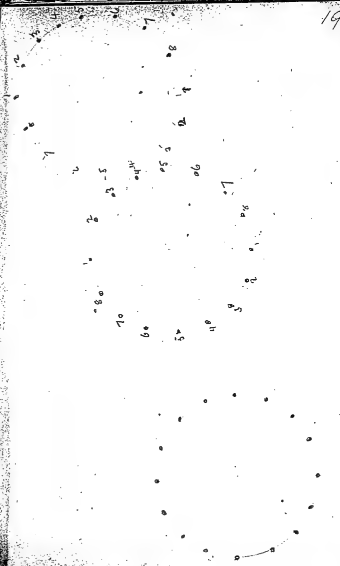
Magnets Oct 15 1879

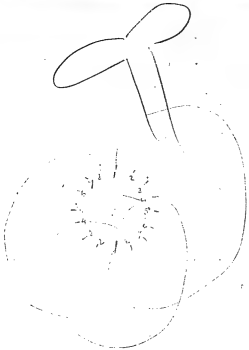
Chas Batchelor

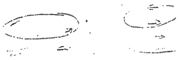












Magnet —
Feb 15 1879
Chas Batchelor

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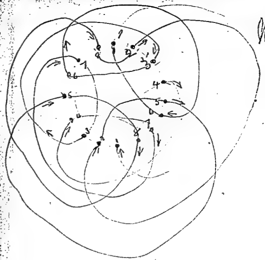
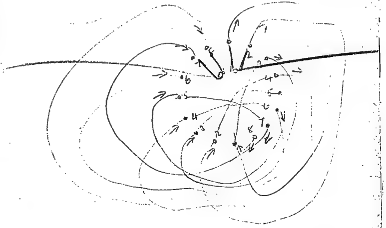
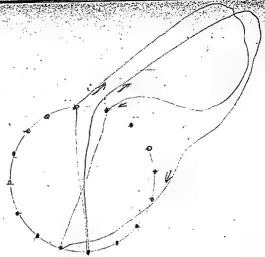
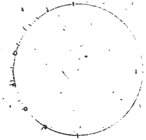


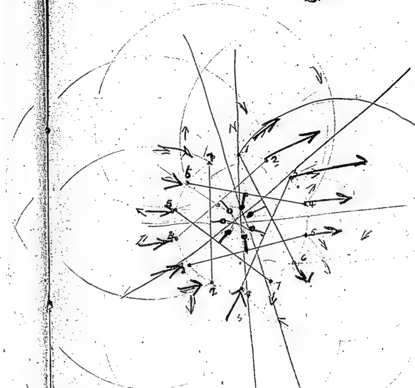


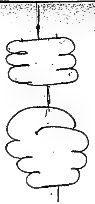


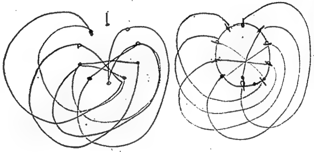


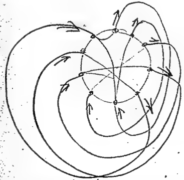
Feb 16 1879

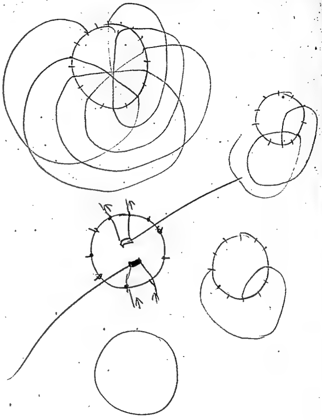
Chas Batchelor

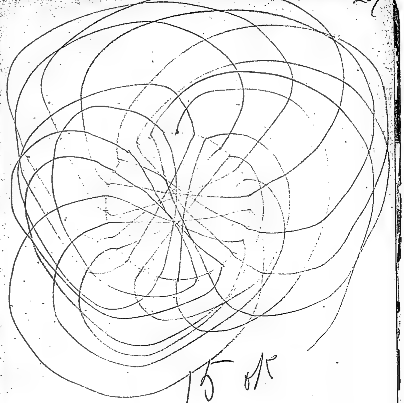






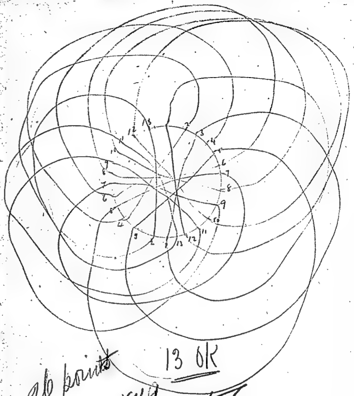






15 ok

31 points
Feb 15 1879
Chas Batchelor



13 OK

26 points

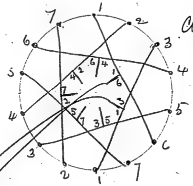
Feb 15 1879

Chas Batchelor

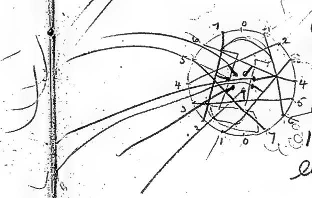
"Pages 131 to 211."

35.1 18.9

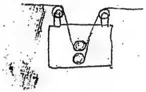
Feb 17 1899
Chas ~~Batchelor~~

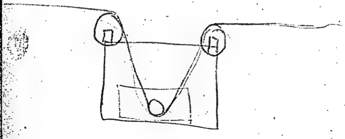


Connections for 7 coils

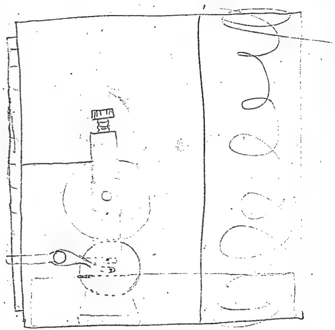


our machine connected as for 7 coils cutting out 1 coil of the eight

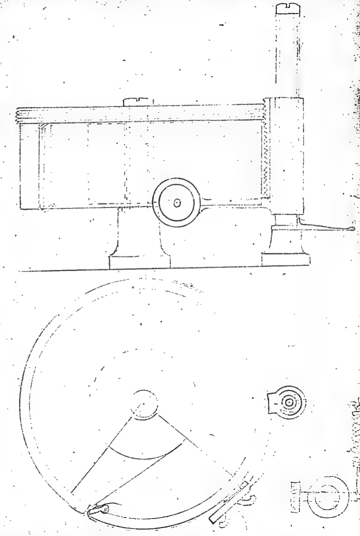




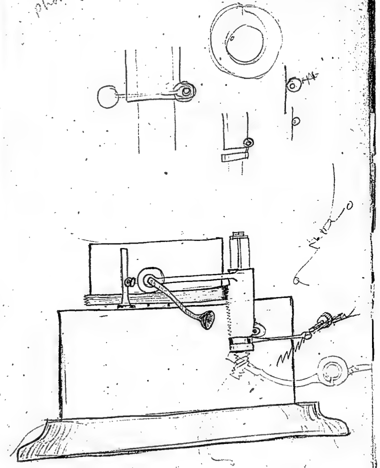
Pages 212 & 213."Edison Electro-Motograph Telepho
Receiver Sketches." (Unimportant)

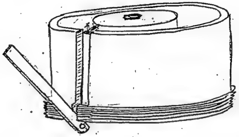


March 10th 1879 215

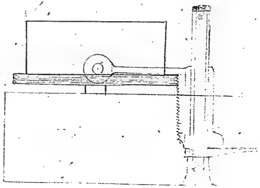


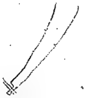
Phonograph

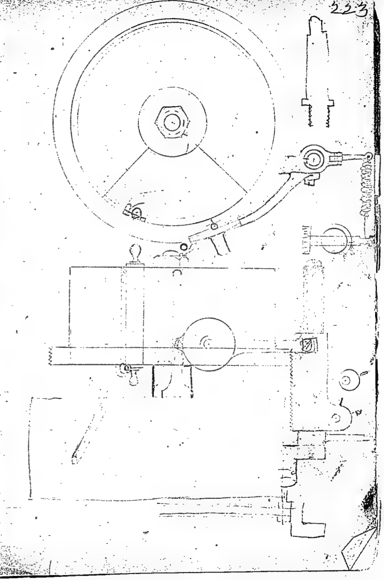




x is small lever to pull the sliding piece on
and out there is also one on bottom



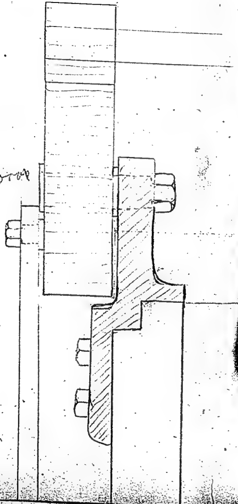




6
3
18

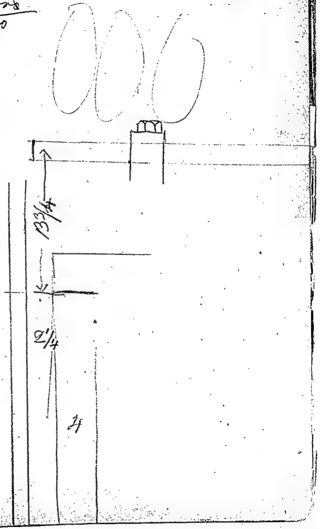
100) 18000

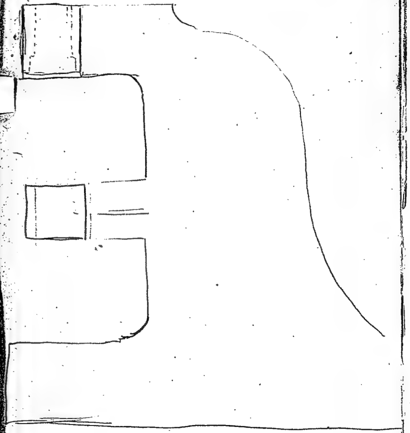
180



1 66) 132 19 228
62 38

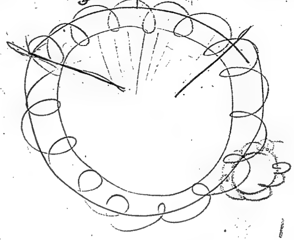
20) 18000
900





.3 .33
1 .2
.1
.1
.05
.02
.02
.01

3.36



2.1
4
.84

3.36

1.68

1.68

.84

100

.005 in Wire

10% Pt Ir.

500 mm 14.6 Ohms

20% 500 mm 12.9 ohms

Platinum 5.7 Ohms

$$\begin{array}{r} \overline{4}.9999 \\ 1.0066 \\ \hline \overline{3}.9913 \end{array}$$

.005

Platinum

500 mm

$\frac{1}{2}$ metre $= \frac{3.28}{2}$ ft $= 1.64$ ft

10%	14.6	1.1644		
	1.64	9.7852		
		0.9496		8.9
20%	12.9	1.1106		
	1.64	9.7852		7.8
		0.8958		
Pt	5.7	0.7559		
	1.64	9.7852		
		0.5411		3.4

per foot

35.1	1.5453
	9.7852
	1.3305
20.9	1.3201
	9.7852
	1.1053
3.23	0.5092
	0.2944
18.9	1.2765
	9.7852
	1.0617
3.56	0.5514
	9.7852
	.3366
71.4	1.8537
	1.6389
11.4	1.0569
	0.8421
.41	T.6128
	T.3980

500 mm

		Wt 100 mm	500 mm	1 foot
20%	.003	10.2 mg	35.1	21.4
	.004	17.4	20.9	12.7
	.005	27.2	12.9	7.9
	.010	109.	3.23	1.97
10%	~~.003~~			
	.004	17.4 mg	18.9	11.6
	.005	25.8	14.6	8.9
	.010	104.	3.56	2.17
Pt	.001	~~9.8~~ 2.87*	71.4	43.5
	.004	19.4	11.4	6.95
	.005	35.9	5.7	3.4
	.02	475.	.41	.25

20%

$\frac{17}{68}$
$\overline{8.5}$

~~98 mm~~

98 mm .0273

Pt 200 mm $\frac{950}{475}$

*Calculated from resistance

Wanted | Cost per oz ~~cost per Ohm~~

~~Length per Ohm~~

Cost per foot

~~Length per Ohm~~

Weight per foot

Feet per oz ~~& per grain~~

Weight per Ohm

Length " "

Cost " "

Ohms per foot

100 mm = .1 metre = $\frac{3.2808}{10}$ = .32808 feet

= 3.937 inches

1 mg = .0154 Grains

= .0000322 oz

$\frac{.32808}{.0154}$ ~~metre~~ feet ~~feet~~ per grain when

100 mm weigh 1 mg

inverse grains per foot

$\bar{1}.5161$
$\bar{2}.1875$
1.3286
8.6714 - 10

$\frac{.32808}{.0000322}$ = feet per oz

inverse oz per foot

$\bar{1}.5161$
$\bar{5}.5079$
4.0082

500 mm an Ohm

Length per Ohm inverse Ohms per foot in inches X 12

Weight per Ohm

Length per Ohm multiplied Wt per foot

Cost per Ohm X price per oz

cost per foot

20% .003 Wire

Wt 100 mm
1/0 2mg

35.1

Capitalize each $16. for Central Station

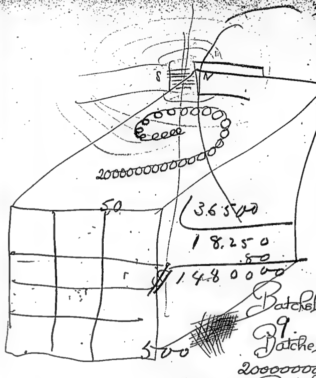
15

3000

35.

Each Station 76 of 3000 h p or
Cap of 18000 burners
90.
300000

Can control each station
framing 3000 h p for
90 dollars per h p
which includes Dynamo
Engine boiler shafting
& every appliance



36.500
18.250
.80
$14.8000

Batchelor
9.
Batchelor
200000000
300 Batchelor
2000000000000000
Batchelor

1 2.

2.

160,
10
1600

365
1600
219000
365
684000

1,74.
80
592,0

80
59
139,
10
1390
365
6950
690
834
4170
507,350

507.350

480) 2,247.00 (46
1 9 2 0
3 2 7 0
2 8 8 0
3 9 0 0
3.9
3

80 hp Engine

burns $1.\frac{74}{100}$ coal per hour per h.p.

would consume in a year 225 tons

Coal at 350,	7.88,00
Wages 1 engineer at 350.	9.12.00
Stoker	5.47.00
	2,247,00

or $4.\frac{68}{100}$ per annum.

1 mil + 1/3 per hour.

or 1 1/3 cents per burner

per day of 10 hours.

according to his own Estimate the cost of ~~1 per~~ each burner for a day of 10 hours, is 4.93 per year.

If a gas jet burning 5 feet per hour for 10 hours daily for 365 days will burn 18.250 feet, the Gas Charge ~~the~~ public for this 41.06, these gas Engineers will whisperingly tell that no one knows how cheap gas can be made but they will admit that it

cannot be made & delivered for less than 60 c per thousand feet, this being the case the actual cost of the gas ~~to any~~ consumed in 1 year from 1 burner of 10 hours is 10.96. cents. now the wear & tear interest in plant is as great with gas as with the Ef hence taking his own statement the cost of a given light when supplied by Electricity is $4\frac{93}{100}$ per annum & by gas 10.96, to say nothing of the Electric light being a much better one

giving off no ~~fumes~~ sulphurous fumes
Carbonic acid or vitiating
the atmosphere by
burning the Oxygen
or blackening the walls

A capitalization of 22
dollars per lamp
Will cover every cost,
but for main Conductors
& Central Station &
Lamps =

& perfectionly accurate
Experiments have shown
that a Company
exploiting the Electric

light can produce in the
house of the Consumer as
much light ~~from~~ 4 to 5 times
less money than it can be
supplied by burning gas —

7000 3.8451
16 1.2041

2.6410
.3200

437.5 2.9610
200

914. instead of 999.

20% .003 500 mm 90/ an oz $22.50 an oz

Wt 100 mm 10.2 mg 1.0086 R 500 mm 3.5.1 1.5453

1.3286 9.7852

2.09 ft per grain .3200 21.4 Ohms per foot 1.3305

7000/116 grains per oz Wt per ft. 1.6800

2.6410 1.3305

914 ft. 2.9610 .0223 grains per Ohm 2.3495

grains per oz 2.6410

Wt per foot 1.6800 oz per Ohm 5.7085

.488 grains Cost per Oz 1.3522

.00109 oz 3.0390 $.00115 cost per ohm 3.0607

cost per foot 225 1.3522 ft per Ohm 2.6695

$ .024 2.3912 :0467

mg per foot 1.6500

.6456 mg 2.8116

.4916

3.102 mg per foot

1.5084

.322 ft per mg

10% 25.8

.005 Feet per grain 1.3286

.4116

Feet per 100 mm 1.9170

25.8 mg in 100 mm

25.8 1.4116

5.5477 -10

6.9593

1/2834 3.9593

28349. mg in 1 oz oz in mg

4.4523

3.9593 oz

1.5159 feet

100 mm 2.4434

1/.3280 ft .0414

2.4848

.0305 .6305

1/1000 oz 1/3 foot

1.00/333 oz in foot

100 mi

25.8 mg

28.000 mg to 1 oz

$\frac{1}{1000}$ oz

100 mm

$\frac{1}{3}$ foot

100 oz in 1 foot

in 1 foot

$\frac{1}{333}$ oz

$\frac{100}{333}$) 11.00 (3.3
999
1010

33 cts

2 inches .02 Pt

100 mm

.475 mg

.475

8.15

$\bar{2}$.6767
5.5477 − 10
$\bar{1}$.5159
0.9112
5.6515
$\bar{4}$.6515

$\frac{475}{28.000}$ $\frac{1}{3}$ .00448

28000)475

80000) 475.000 (.00

54 cts

475 $\bar{2}$.6767
4.48 5.5477 − 10
$\bar{1}$.5159 10.4841 − 10
.9112
41.2 cts $\bar{1}$.6197
16

$\frac{475.}{28000}$ X 3 X 11

475 2.6767
33 1.5185
4.1952
4.4472
$\bar{7}$.7480

.56 cts

475. 2.6767
comp 28349 5.5477 −10
comp log .3280 10.4841 −10
log 8.15 .9112
$\bar{1}$.6197 41.2 cts

$\frac{475}{28000}$ 3 X 8

475 2.6767
24 1.3802
4.0569
.407 cts 4.4472
$\bar{1}$.6097

475. mg. in 100 mm

1 mg weighs $\frac{1}{28349}$ oz.

Wt. 100 ft in ~~grains~~ oz. of wire weighing

1 mg. per 100 mm.

1 mg = $\frac{1}{28349}$ oz 5.5477 −10
100 mm. = $\frac{1}{.3280}$ ft 10.4841 −10
16.0317
$\bar{4}$.0317

.000205

multiply wt. 100 mm in mg = weight per foot mg
X cost oz = cost per ft

5760 grains in 1 lb. Troy 3.7604
1.2153 .0843
3.8447

6999 3.8451
log 7000

$\frac{500}{7000}$
16

~~[illegible]~~
3.8451
1.2041
2.6410

437.5 grains in 1 oz adv.

Cost per foot $\frac{\$}{3.75}$ — Feet per \$ — Weight per Ohm in oz / No. oz in Ohm

Cost per foot (\$)	log	Feet per \$	log		log
.022	1.3522 / $\bar{2}.9999$ / $\bar{2}.3521$	44.	1.6479	.000046	$\bar{4}.9999$ / 1.3305 / $\bar{5}.6694$
.032	$\bar{3}.2318$ / 1.2729 / $\bar{2}.5047$	31.	1.4952	.00013	$\bar{3}.2318$ / 1.1053 / $\bar{4}.1265$
.0403	$\bar{3}.4289$ / 1.1761 / $\bar{2}.6050$	24.8	1.3950	.00034	$\bar{3}.4289$ / 0.8958 / $\bar{4}.5317$
.136	$\bar{2}.0287$ / 1.0969 / $\bar{1}.1256$	7.5	0.8744	.00542	$\bar{2}.0287$ / 0.2944 / $\bar{3}.7343$
.024	$\bar{3}.2318$ / 1.1383 / $\bar{2}.3701$	42.	1.6299	.00015	$\bar{3}.2318$ / 1.0617 / $\bar{4}.1701$
.0281	$\bar{3}.3978$ / 1.0511 / $\bar{2}.4489$	35.6	1.5517	.000280	$\bar{3}.3978$ / ~~1.0514~~ / ~~$\bar{4}.3467$~~ / 3.39781 / $.9496$ / $\bar{4}.4482$
.0.95	$\bar{2}.0083$ / $.9717$ / $\bar{2}.9800$	10.	1.0200	.0067	$\bar{2}.0083$ / 0.3366 / $\bar{3}.6717$
.0075	$\bar{4}.4492$ / 1.3010 / $\bar{3}.7502$	180	2.2498	.0000066	$\bar{4}.4492$ / 1.6389 / $\bar{6}.8103$
.019	$\bar{3}.2791$ / $1.$ / $\bar{2}.2791$	53	1.7209	.00028	$\bar{3}.2791$ / 0.8321 / $\bar{4}.4470$
.0310	$\bar{3}.5500$ / 0.9420 / $\bar{2}.4920$	32	2.5080	.00104	$\bar{3}.5500$ / 0.5311 / $\bar{3}.0189$
.374	$\bar{2}.6643$ / 0.9096 / $\bar{1}.5739$	26	0.4261	.185	$\bar{2}.6643$ / $\bar{1}.3980$ / $\bar{1}.2663$

Cost per Ohm — \$ — Ohms per \$ — In long are ohms

Cost per Ohm (log)	\$	Ohms per \$ (log)		In long are ohms (log)	
$\bar{2}.6695$		2.9784	950	0 $\bar{2}.9914$	
$\bar{2}.3521$		2.5008	317	0 $\bar{2}.9595$	
$\bar{3}.0216$	.00105	2.2888	194	0 $\bar{1}.5624$	3.65
$\bar{2}.8945$		1.1680	14.7	1 $\bar{3}.9626$	
$\bar{2}.5047$		2.6916	490	0 $\bar{1}.7594$	
$\bar{3}.4092$	.0021	2.5007	316	0 $\bar{1}.5935$	3.93
$\bar{1}.1042$		2.3566	230	1 $\bar{3}.9830$	
$\bar{2}.6050$		3.8887	7700	1 $\bar{1}.5421$	
$\bar{3}.7112$	.00514	2.5530	350	0 $\bar{1}.7122$	
$\bar{1}.7015$		2.0491	112	0 $\bar{2}.4448$	276
$\bar{1}.1256$					
$\bar{2}.8312$	.0679	$\bar{1}.7240$	.53	1 $\bar{2}.3270$	

No. Ohms in 1 oz — Feet in oz

Cost per Ohm (log)		No. Ohms in 1 oz	log	Feet in oz	log
$\bar{2}.4383$					
$\bar{2}.2701$	.0020	21000	4.3306	.0322	$\bar{2}.5073$
$\bar{3}.3084$		7500	3.8735	.0188	$\bar{2}.2754$
$\bar{1}.0500$		2940	3.4689	.0120	$\bar{2}.0797$
$\bar{2}.4989$					
$\bar{3}.4993$	.00315	184	2.2657	.00304	$\bar{3}.4785$
$\bar{1}.5058$		6700	3.8299	.01888	$\bar{2}.2754$
$\bar{2}.9934$	.044	3550	3.5517	.0127	$\bar{2}.1043$
				.00319	$\bar{3}.4989$
$\bar{2}.3611$		210	2.3263	.114	$\bar{1}.0580$
$\bar{3}.7502$	.00313	154000	5.1897	.0169	$\bar{2}.2281$
$\bar{4}.1113$		3600	3.5530	.00914	$\bar{3}.9608$
$\bar{1}.1679$		957	2.9811	.000069	$\bar{4}.8429$
$\bar{2}.2791$	.0028	6820	3.8337		
$\bar{3}.4470$					

No. Grains in 1 Ohm — No. mg. in 1 Ohm

Cost per Ohm (log)		No. Grains in 1 Ohm	log	No. mg. in 1 Ohm	log
$\bar{1}.4689$		.023	$\bar{2}.3506$	1.45	0.1622
$\bar{2}.4920$	.00914	.064	$\bar{2}.8077$	4.1	0.6193
$\bar{3}.9609$		.163	$\bar{1}.2123$	10.5	1.0239
$\bar{1}.7020$					
$\bar{1}.3757$	1.88	2.64	0.4155	168.	2.2271
.2757		.071	$\bar{2}.8513$	4.6	0.6629
		.134	$\bar{1}.1293$	8.54	0.9313
		2.25	0.3529	146	2.1645
		.0031	$\bar{3}.4915$	.2	$\bar{1}.3031$
		.107	$\bar{1}.0282$	6.9	0.8398
		.502	$\bar{1}.7005$	32.5	1.5117
		88.6	1.9475	5750.	3.7591

27 Ohm
25 Lamp
2 Battery

1 Lamp
2 Ohms Battery

$C = \frac{E}{R} = \frac{1}{3}$

$\frac{1}{9} \times \frac{3}{2} = \frac{1}{3}$

$C = \frac{E}{R} = \frac{1}{27}$

$\frac{1}{27} \times \frac{1}{27} \times \cancel{27} 27 = \frac{1}{27}$

$\frac{1}{27}$ is $\frac{1}{9}$ of $\frac{1}{3}$

$\frac{1}{9}$ as much energy total on 27 Ohm circuit.

$\frac{1}{9}$ $\frac{1}{3}$ Total.

$\frac{1}{9}$ in battery

Cost $\frac{2}{9}$ in Lamp

$\frac{1}{27}$

$\frac{25}{27 \times 27}$ $\frac{2}{27 \times 27}$ $\frac{27}{142}$ (6)

$\frac{6}{27} = \frac{142}{27 \times 27}$

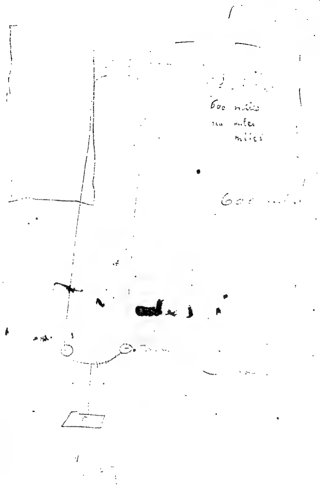
$25) 142 (5.7$
125
175

5.7 ~~times~~ more energy given off on 1 Ohm lamp than on 25 Ohm lamp.

Platinum wire marked
·005 measures in different
places ·00575 ·00590 ·0060

Platinum Iridium 10/o.
Marked ·005 measures
·005 only being ·0049 in one
place near end

Plat Iridium 20 o/o
Marked ·005 measures



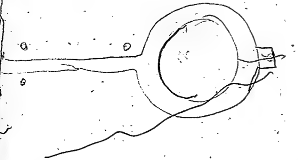
No. 1 42.305

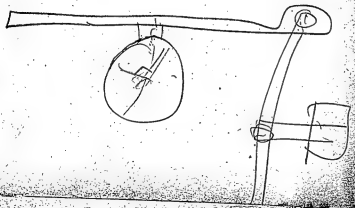
2 43.62

2 cells 5 Ohms

2-25

2.47 22 minutes





.11363 Mg.

.00011363 Grammes

.0011363 $\frac{1}{10}$

.011363

Daniell's element D = 11

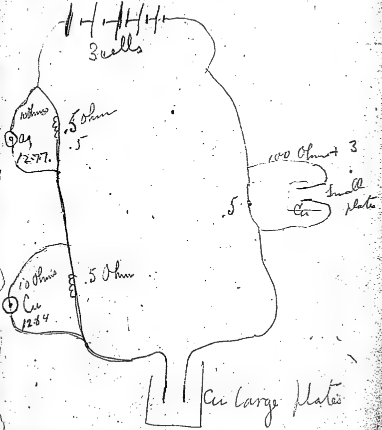
Volt = $\frac{1}{10}$ Magnetic [illegible]

.00093 E.B. .00094

000 0094

00094

I want to try the following



Time 3-24 P.M.

7-45

c^2 3, 24

R^2 4 21

60
240
21
261

7.8
3
5.4
1.5
1.0
7.9

8 Ohms

log	3	0.4771	
comp log	8	9.0969	−10
comp log	1.14	9.9431	−10
log	3	0.4771	
log	1.015	0.0065	
comp	261	7.5837	
comp	60	8.2218	
		$\bar{4}$.8062	

.00064

Pt crucible.

15.792

15.8975
15.792
.1055

Small bent Cu.

7.0752

7.0952
7.0752
.0200

Large plate

41.8672
.8336
4

Large plate corner cut

40.850

41.8338
40.850
.9838

L

without cut

40.986
39.940
1.046
.983
63
32

983
32
1.015

26) 1.015 (.63

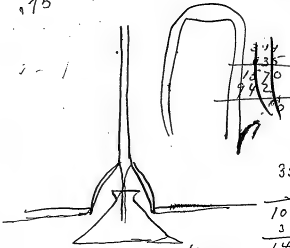
Small plate

12.5768
12.557
.0198

1030
.125

.016
11.996
.020

.175



3.14
1.35
1570
942

13
35 39
3
105
39
145
130
615
.035

.035
.0175

3.14 .4970
.0175 $\bar{2}$.2430
.0175 $\bar{2}$.2430
5.9830

3868

.000967
4
.003868

.030
130
3900

030
090
2700
130

30
31
720
6
31
3720

.035

3.14
.0175
.0175

.4969
2.2430
2.2430
2.9829

30 220
110 Volts

110
110
110
110
1210
443
3630
4840
4840

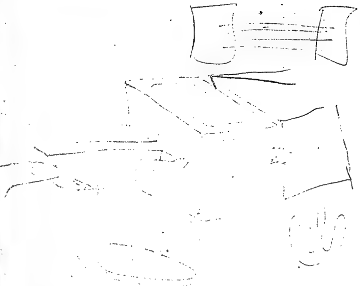
88) 536.030 (6.08
528
803
724
790

5.5 per H.P.

5360

3a 22a
7.33
12
1466
733
87.96

6088) 33000 (5.4 per H.P
30440
25600
24462



154
16
70

.0175	$\bar{2}$.24304	13
.0175	$\bar{2}$.24304	52
3.14	0.49693	35
	4.98301	4

140
52
192
30
162

.0009617

.01
.01
.0001

0.961

30)961(32.0

.035
.035

.024
.162

.0009687
4
.0038472

.024
.162

30)3847(1

128
30

35
0

.024
.162

.024
-162

162)3847(23
324
607
486
1210

1795049
5
8975245

61,162570
8975245
52187325

7162360
-3275105
10437465
5
52187325

12,232514
1795049
10437465

7162360
5
35811800

7,484,~~000~~) 39,100,~~000~~ (5.22
37 420
16800
14968
18320

624 3000
5
3,121.500

627.200
5
3136 000

134.032
5
356,336) 670,160 (1.8
3563
31380
~~32504~~

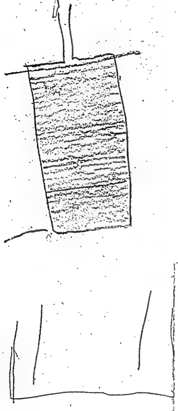
Motor No. 2.

Menlo Park Notebook #10 [N-78-12-16]

This notebook covers the period December 1878-January 1879. Most of the entries are by Francis Upton. There are also entries by Edison and Charles Batchelor. Some entries have been signed by Edison. Almost all of the material relates to experiments on electric lighting. Included are calculations by Upton about generators and electric distribution systems, with a few calculations by Edison; notes and drawings of lamps; and notes and drawings of generators. There are also notes by Upton on miscellaneous subjects, from etheric force, electricity, magnetism, and phosphorescence to light and heat. Similar notes can be found in Menlo Park Notebook #15. The book contains 282 numbered pages.

Blank pages not filmed: 88-89, 198-201, 280-281.

No 10

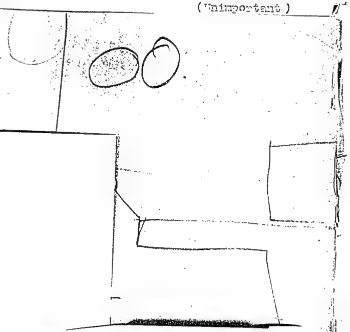


50
10
500

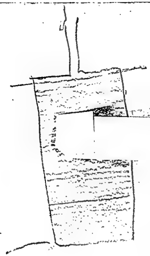
500

1

Pages 1 to 16."Incandescent Lamp Calculations".
(Unimportant)

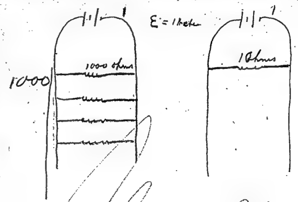


No 10



50
10
500

500



$$Heat = R C^2$$

$$\mathcal{E} = 1$$

$$C = \frac{\mathcal{E}}{R + r}$$

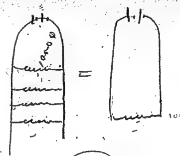
$$\frac{1}{1000} +$$

$$\mathcal{E} = \cancel{\frac{1+1}{1000}} = \cancel{1000}$$

$$\mathcal{E} = 1 \quad C = X \quad r = 1 \quad R = 1000$$

$$C = \frac{\mathcal{E}}{1 + 1000}$$

$$Heat = \frac{\mathcal{E}^2}{1001^2} \cdot 1000$$



100 lamps 1 ohm

100 ohm Each.

Heat = $R\,C^2$

$C = \frac{E}{R+r}$

$E = 2$

$R = \cancel{100} = 1$

$r = 1$

10,000.

$100 \overline{)10000}$ 100

$100 \overline{)1000}$ 10

1	1000
2	500
4	250
8	125
16	62 $\frac{1}{2}$
32	31 ·25
64	15 ·62

$\frac{1}{1000}$

$\frac{1}{10000} \quad 10000 = 1$

$1 = \frac{1}{100} = \frac{1}{1000}$

$\frac{1}{10000} \times 10000 = 1$

1.1

$C = \frac{E}{\frac{x}{100}+1} = \frac{1}{\frac{x}{100}+1}$

$\text{Heat} = \frac{1}{\frac{x}{100}+1} \cdot \frac{1}{\frac{x}{100}+1} \cdot x$

$\frac{x}{\frac{x^2}{10000} + \frac{2x}{100} + 1} = \frac{1}{10101}$

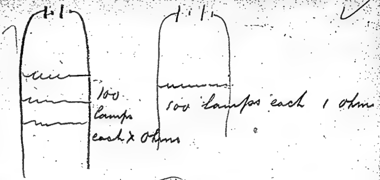
$10101\,x = \frac{x^2}{10000} + \frac{2x}{100} + 1$

$101010000\,x = x^2 + 200x + 10000$

$x^2 - 101010000 = 10000$

$x^2 - 101010000$

50000000



$E = 1 \qquad \text{Heat} = C^2 R$

$R = 100 \qquad R = 100 \qquad C = \frac{E}{R+r}$

$r = 1$

$C = \frac{E}{1+100} = \frac{1}{101} \qquad 100$

$\text{Heat} = \frac{1}{101} \times \frac{1}{101} \times 1$

$= \frac{1}{10{,}101}$

$\text{Heat} = \frac{E}{1+}$

$x - 50000000 =$

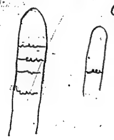
$\frac{1}{1000}$ $\frac{1}{1}$

$1000 \times \frac{1}{100000} = \frac{1}{100}$

$\frac{1}{100} \cdot 1 = \frac{1}{100}$

Heat = $C^2 R$

C in whole = 1



1 oz. Zn. per lamp

10000 in each

$\frac{10000}{100}$ = 100 Ohms in all

$\frac{1}{100}$ of current in each

$\left(\frac{1}{100}\right)^2 = \frac{1}{10000}$

$\frac{1}{10000} \cdot 10000 = 1$ Heat in each lamp

---

100 Ohms in all
1 Ohm in each lamp
1 Current in each lamp
1 = 1×1. Heat in each lamp.

10

Heat = ~~$\mathcal{E}^2 R$~~

$C = \frac{\mathcal{E}}{R}$

Heat $\mathcal{E}^3 R$

Heat = $C^2 R$

1111 1 oz

100

100 100 $C = \frac{1}{2}$

100 100

$C = \frac{100}{100+100} = \frac{1}{2}$

$C = \frac{3}{2} \,\Big|\, \frac{1}{R}$

11

$C = \frac{\mathcal{E}}{R+r}$

1 oz 1

$C = \frac{1}{1+1} = \frac{1}{2}$

$C = \frac{2}{1+2} = \frac{2}{3}$

141

$\frac{4}{3}$ oz ~~1 oz $\frac{4}{3}$ oz~~ 1 $1\frac{2}{3}$

$1\frac{1}{3}$ $H_1 = 1\frac{1}{3}$ $1\frac{1}{3}$

$1\frac{1}{3}$ $1\frac{1}{3}$

100 X 100

$C = \frac{1}{2}$

Page 235 / 217

$C^2 R$

$$C = \frac{\varepsilon}{R}$$

$$C^2 R =$$

$$\frac{\varepsilon^2}{R^2} R = \frac{\varepsilon^2}{R}$$

$$C^2 R = \frac{\varepsilon^2}{R} \qquad \varepsilon$$

$C^2 R$

$$C = \frac{\varepsilon}{R}$$

$$\frac{1}{4}\, 2 = \frac{1}{2}$$

$$\frac{2}{3} \cdot 3 =$$

$$\frac{4}{9} \cdot 3 = \frac{4}{3}$$

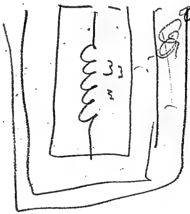
$$\frac{2}{3}$$

$1 \quad \frac{8}{3}$

$1 \quad 2\tfrac{2}{3}$

Joule

1842



$$C = \frac{1}{1001}$$

$$\frac{1}{(1001)^2} \cdot 1001$$

Hard

$$\frac{1}{1001}$$

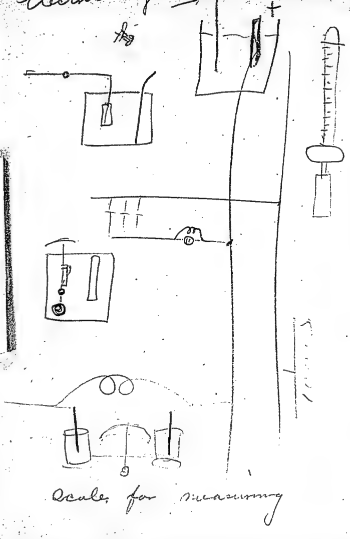
124
3
36
60
2.160

$$C = \frac{2}{1002}$$

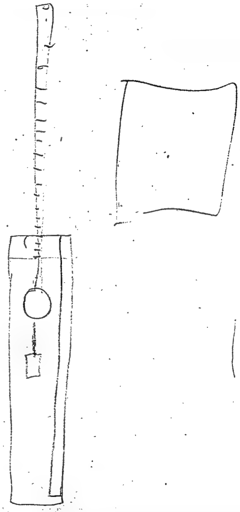
$$\frac{4}{(1002)^2} \cdot 1002$$

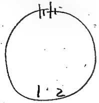
$$\frac{4}{1002} \quad \frac{1}{250}$$

Electric light — metres Dec 20 /77



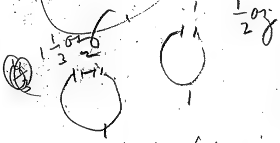
Scale for measuring





$\mathcal{E} = \frac{1}{1+1} = \frac{1}{2}$

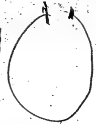
$C = \frac{2}{2+2} = \frac{1}{2}$



$c = \frac{1}{1+1} = \frac{1}{2}$ Veber

$c = \frac{2}{2+1} = \frac{2}{3}$

$r = 1 \quad \mathcal{E} = 1$



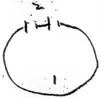
$R = 1$

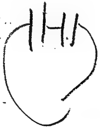
$c = \frac{\mathcal{E}}{R+r}$

$c = \frac{1}{1+1} = \frac{1}{2}$

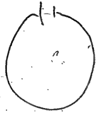
$c = \frac{2}{2} = 1$

$c = \frac{2}{2+1} = \frac{2}{3}$





1

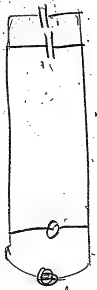


$= 1$

1

$$C = \frac{1}{\frac{1}{2}+1} = \frac{1}{\frac{3}{2}} = \frac{2}{3}$$

$1\frac{1}{3}$



$110 - 100 = 10$

110°

12 inches long

1

100,

110°

200°

1 ohm

110°

$\frac{1}{10}$

2 mile $\frac{1}{4}$ = 20 km

$\frac{1}{10000}$ ① = 20

$\frac{1}{20000}$ $\frac{1}{1.6}$

$\frac{\pi D^2}{4}$

$16 \overline{)20000} \; 1250$

1.6

40

32

80

80

$\frac{\pi D^2}{4} \frac{1}{2000}$

$\frac{\pi D^2}{4} = A$ $\frac{1}{10000}$

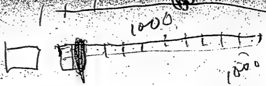
$12350 (3$

4

$\overline{)350}$

$\frac{\pi D^2}{4} = \frac{20000}{20000}$

$\frac{1}{5000}$



10 inch 1000 2000

110

6

120

3

140

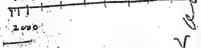
1/2

180

3/4

260

1000.



20.

100 · 40 ·

110

100

1/2

200

400

4000

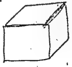
2000

1000

30

15

7 1/2



$C = \frac{E}{R+r}$

$C = \frac{1}{1+1} = \frac{1}{2}$

$C = \frac{1}{\frac{1}{30}+1} = \frac{30}{31}$

1 2

2 horse power Dec 16 27

Cu. rod $\frac{1}{4}$ in diameter

Length 30 inches

~~1.6744~~

.1654

1000

12000 : 30 :: .1654 : 400

4000 ~~66.1600~~

400) .1654

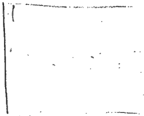
.00041 35

10004

.0004

$$\frac{413}{10000} = \frac{1}{2500}$$

$$\frac{1}{2500} \qquad 1000^{0}$$



12000 : 300 :: .1654 :

400 : 1 :: .1654

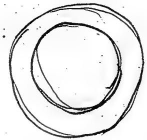
$$\frac{.1654}{400} = \frac{.001654}{4}$$

.000413 Ohm

$$\begin{array}{r} 6046.5 \\ 12 \\ \hline 120930 \\ 60465 \\ \hline 72558. \end{array}$$

72558 : 30 :: 1 :

$\frac{1}{2500}$ ohm



$\frac{1}{4}$

12 ~~8 inches~~

$$\left(\frac{1}{4}\right)^2 = \frac{1}{16}$$

$$\frac{12}{16} = \frac{3}{4}$$

$$\left(\frac{1}{4}\right)^2 \pi \qquad \frac{1}{16}$$

$$\frac{1}{12}\,(X)^2 \pi$$

$$\frac{12}{16} = \frac{3}{4}$$

$\frac{\pi D}{4} = A$

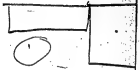
$D = \frac{4}{\pi} A$

$= \cancel{\frac{4}{\pi}} \frac{3\cancel{\pi}}{16} = \frac{3}{4}$

3

$\frac{3}{4}$ $\frac{9}{16} \times \cancel{12}^{1} =$

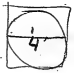
$\left(\frac{9}{16}\right) \left(\frac{3}{4}\right)^2$



$\frac{1}{4}$ 12

$\frac{1}{16}$ 12 area

$\frac{12}{16} = \sqrt{\frac{3}{4}}$



$\frac{1}{4}$

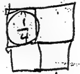
$\frac{1}{16}$ $\left(\frac{12}{16} \pi\right)$

$2\pi R$

$\pi R^2 = \pi \frac{D^2}{4}$

$\frac{1}{16}$ $\frac{1}{8}$ $\frac{1}{64}$ $\frac{3\pi}{16}$ $R = \frac{D}{2}$ $R^2 = \frac{D^2}{4}$

$\frac{12\pi}{64} = \frac{3\pi}{16}$



$\frac{1}{4}$

$\frac{1}{4}$ $\frac{1}{16}$

$\frac{1}{8}$

$\frac{\pi D^2}{4}$ $\frac{1}{64}$ π

64)3.1415(.049 .049
256
581
512

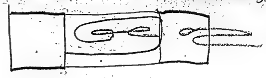
56 Ends

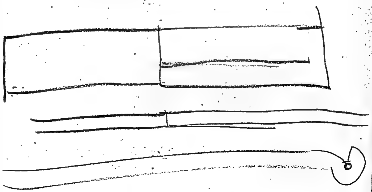
$\frac{1}{4}$

64) 2 .49

$\frac{1}{.05}$

$\frac{5}{100}$ $\frac{1}{20}$





960 Lamps 960 Lamps

480°

160
64)320.0(5
320

$\frac{1}{4}$

$\frac{\pi D^2}{4}$ $\frac{\pi \frac{1}{16}}{4}$

4

$\pi \frac{1}{64}$

$64 \overline{)3.1415}(.04$

$\frac{5}{100}$

$\frac{1}{20}$ $\frac{60}{20} = 3$ inches

30

$4 \overline{)3.14\cancel{16}}$

.785

30

2.3550

2,355

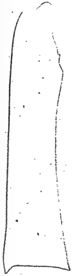
23,55

3.

26. $\frac{1}{2}$

7

$\frac{3}{4}$



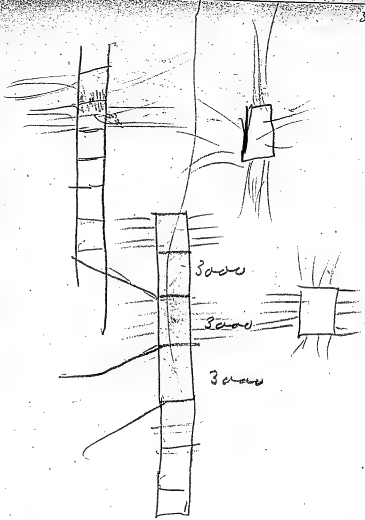
23. $\frac{1}{2}$

$\frac{3}{5}$ 5.4

~~27) 5.4 (2~~
~~58~~

5.4) 250 (4
216
44

5.4) 270 (5

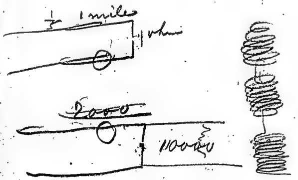


10000

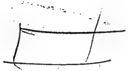
2500

1000 2000

2000 2000



Light



$$\mathcal{E} = \frac{\varepsilon}{R+r}$$

6640

$\frac{1}{2}$

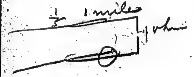
2700°

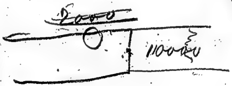
100000

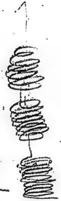
2500

1000   2000

2000   2000

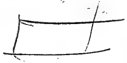






Light

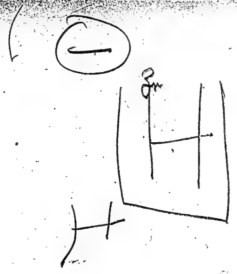
1 H.P.



$$\mathcal{E} = \frac{E}{R+r}$$

6640

0.022

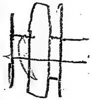


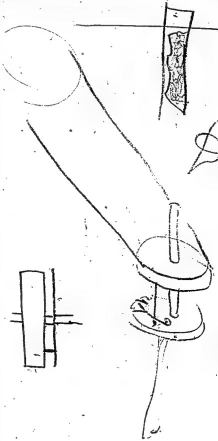
Dec 18 1878
TAE

Dec 18 1878
TAE

Dec 18 1878
TAE

Space X pressure = work





Dec 18 1878
TAE

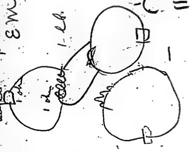
141

800 20
120 20

10
6
60

C R

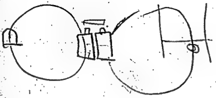
1 hp EMF 1
1 el.
1 ohm
magnet 1 ohm



$C = \frac{E}{R}$

$1 = \frac{1}{1}$

$C = \frac{2}{1}$

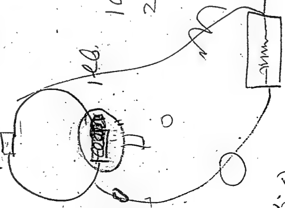


Dec 18 1878
TAE

47

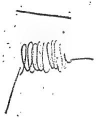
Dec 18 1878
TAE

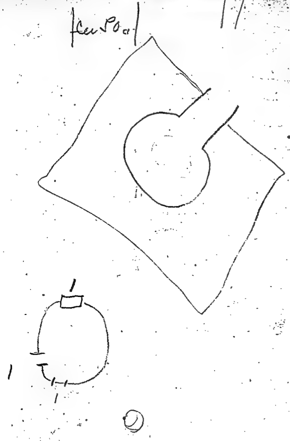
1 hp. 1, EMF
10, 5
20,
10,
1 el.
magneto 1 ohm

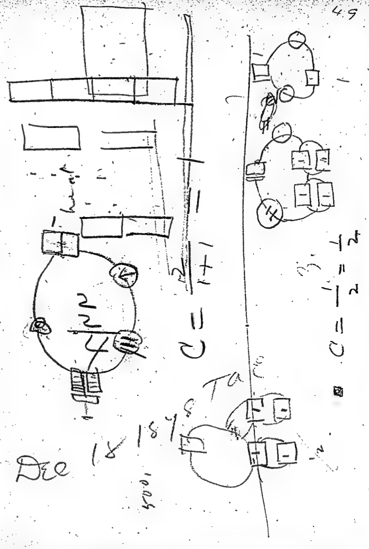


70
50

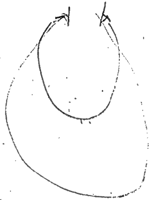
65
60
55



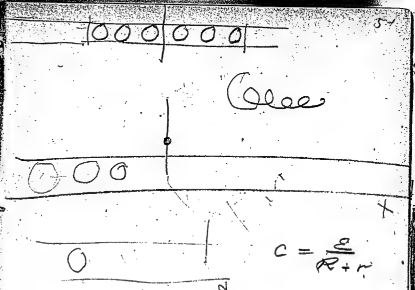



Dec

4



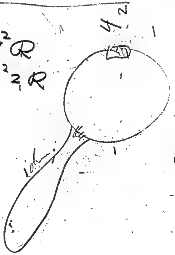
$$C = \frac{10000}{17.00}$$



$$C = \frac{E}{R+r}$$

$$H = C^2 R$$

$$2H = C^2 2R$$



$$C = \frac{E}{R+r}$$

$$C = \frac{2E}{2R}$$

As. 4225 : 4356 :: 330

$$\begin{array}{r} 4356 \\ 330 \\ \hline 13068 \\ 13068 \\ \hline \end{array}$$

$$4225 \overline{)1437480} \; 340$$

$$\begin{array}{r} 12675 \\ \hline 16998 \\ 16900 \\ \hline 980 \end{array}$$

$$\begin{array}{r} 80 \\ 80 \\ \hline 6400 \end{array} : 4356 :: 340$$

$$\begin{array}{r} 340 \\ \hline 17424 \\ 13068 \\ \hline \end{array}$$

$$8 \overline{)14810\cancel{40}}$$

$$8 \overline{)1851}$$

231

Dec 16 1918

4356 : 6400 : 340

340

25 6000

192

4356) 2176000 (500

21780

0

80

80

2) 6400

8) 3200

400

81 / 6.25

$G = .1$ Ohm

$C = 1.$ Ohm

$D = .2$ "

$r = .2$

$R = 1.3 + .528$

$= 1.828$

$\mathcal{E} = \frac{\mathcal{E}}{1.828 + .2} = \frac{\mathcal{E}}{2.028}$

$\mathcal{E} = 2.028$

$C = 1$

---

14 5 3 4

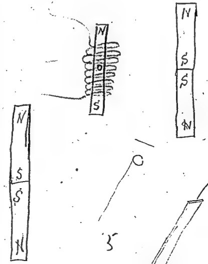
$$\begin{array}{r} 75 \\ 8 \\ \hline 83 \end{array}$$

1 Equiv 2.248 10.503

10000

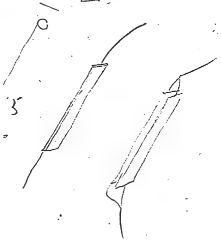
Dec 18 1878

TAE



$$\begin{array}{r} 14 \\ 200 \\ \hline 2800 \end{array}$$

5



5

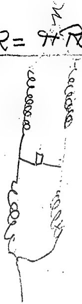
$$\begin{array}{r} 14 \\ 200 \\ \hline 2800 \end{array}$$

$\pi R^2 = A$

$\pi D = C$

$2\pi R \times \frac{1}{2} R = \pi R^2$

$$\begin{array}{r} 5236 \\ 6 \\ \hline 3.1416 \end{array}$$



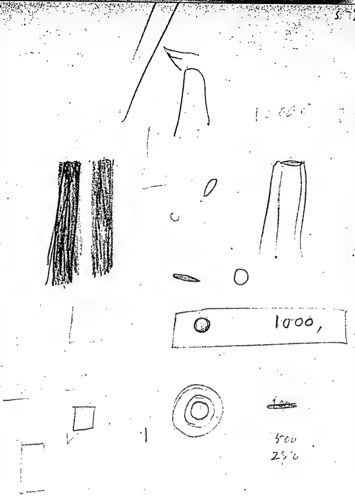
$\frac{1}{6}\pi D^3$

$3/16$

$4\pi R^2$

πD^2

$\frac{1}{6}(\pi D^2) D$



60

$\frac{3}{16}$

16) 3.0 (.183
16
140
134
60

2(.183
.1091

.091
.091
91
819
.008281
3141
8281
33124
~~24843~~
8281
24843
.026011~~621~~

16 ~~ds~~

πr^2

$4\pi R^2$

.026

10

61

.026
~~.104~~
1.04

~~1000°~~ 1000
~~200°~~ 250
~~200~~ 25

$\frac{3}{16}$

$(\ )^2 \pi = A$

$\left(\frac{3}{16}\right)^2 \pi = A$

$\frac{9}{256} \pi = A$

9

16
16
96
16
256

256) 28.2744 (.11
3.1416
9
256
267
256
11 4

$\frac{1}{10}$ inch

$\frac{1}{10}$ inch 1000°. 5000°

1 inch 100°. 500°

62

82^0

$\frac{1}{12}$ / 6 0000

12

720,000

15

3,600,006

72

10,800,000,000 ~~p~~

~~per mm~~

2 3

11 000 000

~~7~~ 8 3,3 00.

$\frac{1}{1000}$

5 [illegible] ft

63

14)3600

1200

15 1000

60

~~10000~~

340

~~30000~~

15

5

12

~~12/60000~~

~~1000~~

60.000

64

2 lbs

$\frac{1}{30}$ lt

1,120)196000(1.76.
1120
84000
7840
6600

1760

1.120
90

Dec 18 1878
TAE

10000 65

10000

2200 Cr 1 Ton Coal
40

destroyed
1340
from one ton 1300 destroyed to make 10000 cu ft gas
1300 lbs = 10000 ft of gas one hour
5

5/10000
2000 = Gas burners for one hour
= 30000 candles

1300 2/1300 Dec 18 1878
2 650 TAE

650)30000(4
2600
4000

650
600 candles Jablochkoff
390000
13

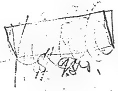
650
6
3900

650
90
58500

650 Horse power
6 lamps per horse.
6 X 15 candles " " = 90

650
90
58.500 candles for 1300 lbs
of coal

Dec 18 1878
Thu



772) 33000 (42
3088
2120
4

1.

355
42

Dec 18 1878
.0355

Thu

.0355

33.
42
66
132
1386.

1386 lbs of Rt. heated in
one

1386 degrees Fahr. 1 degree.

30	28	19
34	91	16
55	76	13
139	195	48

67	40
46	46
38	40
151	126

Dec 18 1878

Jag

$$C = \frac{8}{3+2} = \frac{8}{5}$$

$$Heat = C^2 R = 7.7$$

$$\left(\frac{8}{5}\right)^2 3 = \frac{64}{25} 3$$

$$25 \overline{)192} (7.7$$
$$\underline{175}$$
$$170$$

Heat = 7.7

$$C = \frac{8}{2+6} = \frac{8}{8} = 1$$

$$Heat = C^2 R = 1 \cdot 6 = 6$$

Heat = 6.–

Dec 18 1878
TAE

Battery 2 Ohms
Lamps 3 Ohms
Electromotive 8

2
1.6

$\frac{1}{4}$ inch radiating sur-
face

Battery 2 Ohms
Lamp 6 "
8

$\frac{1}{4}$ in radiating surface

Dec 18 1878
TAE

Dec 18 1878
TAE

Lamp = 6

$C = \frac{8}{1.6+6} = \frac{8}{7.6}$ 7.6) 8.0 (1.05
7.6
400

1.05
1.05
525
105
1.10
6
6.60 = Heat

Battery 1.6
Lamp 3.0
E. F. 8

Not 1

1/4 in

Dec 18 1878
TAE

Lamp 6

$C = \frac{8}{3+1.6} = \frac{8}{4.6}$

4.6) 8.0 (1.74
4.6
340
322
180

1.74
1.74
696
1218
174
3.0576
3
9.15 ~~08~~ = Heat

9.15

No 1

$$C = \frac{E}{R + r}$$

$$C = \frac{2E}{R' + 2r}$$

$$\frac{E}{R + r} = \frac{2E}{R' + 2r}$$

$$R' + 2r = 2R + 2r$$

$$R' = 2R$$

$$C = \frac{E}{\quad}$$

Dec 18 1878

TAE

$$C = \frac{E}{R + r}$$

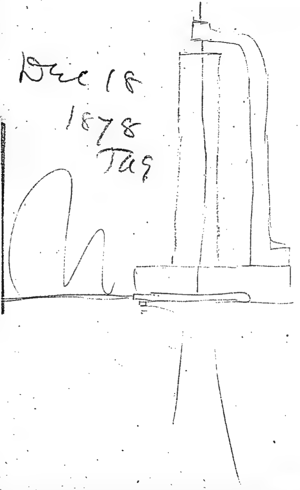
$$C = \frac{E}{R' + \frac{r}{2}} = \frac{E}{R' + \frac{r}{2}}$$

$$R + r = R' + \frac{r}{2}$$

$$\frac{r}{2} = R' - R$$

$$r = 2(R' - R)$$

Dec 18
1878
Tag



78

79

Lamp with ~~6~~ in of 15/1000 wire with points 12 inch long, ~~th~~ Glass tube round wire also a tube & 6" wire for same

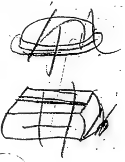
To record on glass run by Wheatstone machine

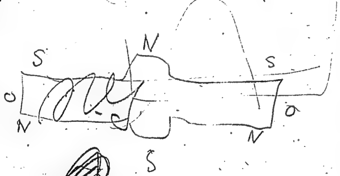
Small key with bristle for record

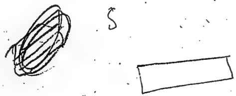
DEC 18 1878
TAE

$$C = \frac{a}{R+r}$$

Dec 18 1878

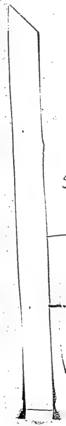


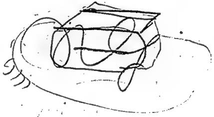


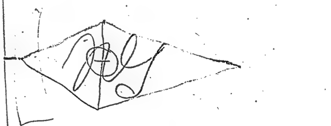


$$C = \frac{E}{R+r} = \frac{2E}{2(R+r)} = \frac{2E}{2R+2r}$$

$$2R+2r = 2r$$







Dec 18

$$C = \frac{E}{R+r}$$

$$C' = \frac{E}{R'+r}$$

$$\frac{C}{R+r} = \frac{C'}{R'+r}$$

$$CR' + Cr = C'R + C'r$$

$$r = \frac{C'R - CR'}{C - C'}$$

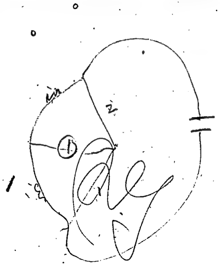
$$C = \frac{E}{R+r} = \frac{E}{R' + \frac{r}{2}}$$

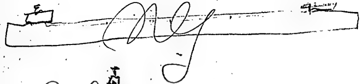
$$2R' + r = 2R + 2r$$

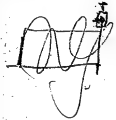
$$r = 2(R' - R)$$

Dec 18 1878

TAE







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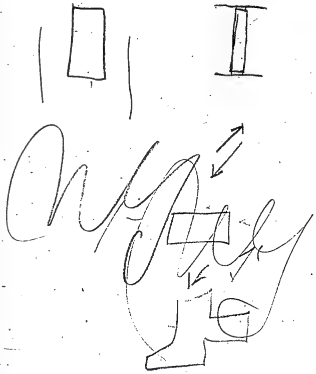
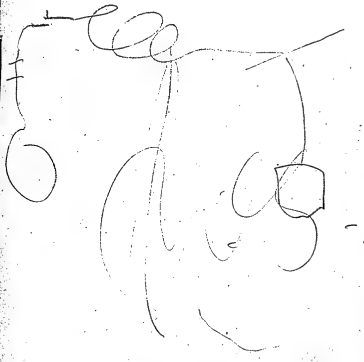
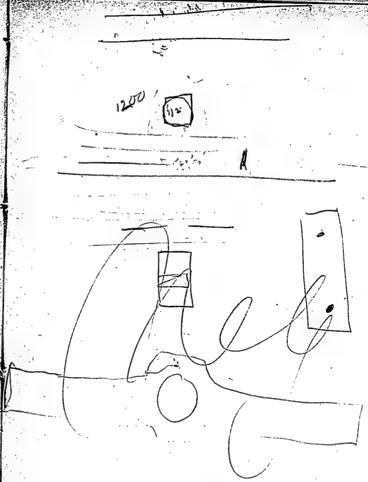
TAE

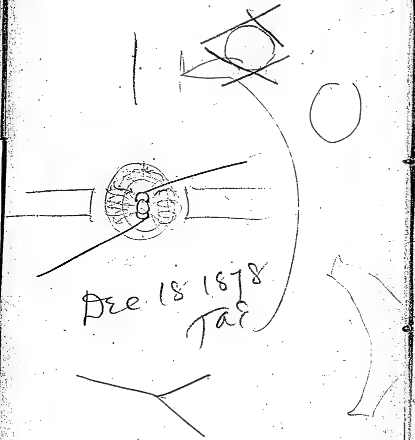


Dec 18 1878 TAE





Dec 28 1878
TAE



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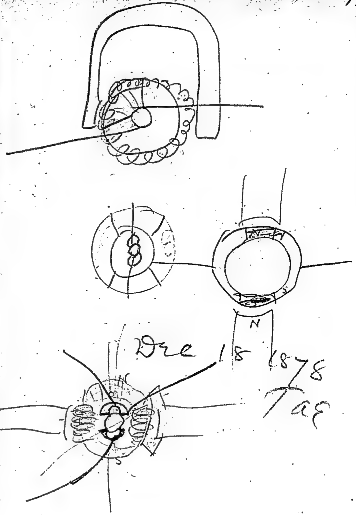
TAE



Dec 18 1878
TAE

r = 10 Ohms

1 H. P. R = 10 Ohms

r = ~~8~~ Ohms R = 2 Ohms

$C = \frac{\mathcal{E}}{R + r} = 1$

$C^2 -$ Dec 18 1878 TAE

$$\begin{array}{r} 3.06 \\ .10 \\ \hline 30.06 \end{array} \qquad \begin{array}{r} 1.75 \\ 1.75 \\ \hline 875 \\ 1225 \\ 175 \\ \hline 3.0625 \end{array}$$

1 Cell of # r = 10 Ohms

1 " " r = 2 Ohms

10 Ohms outside

$\mathcal{E} = 20$

$C = \frac{20}{10 + 10} = \frac{1}{20} = 1$

$C = \frac{20}{10 + 2} = \frac{20}{12} = 1\,3/4$

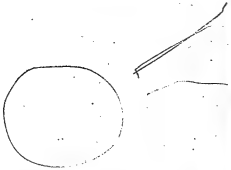
Dec 18 1878 TAE

$C =$

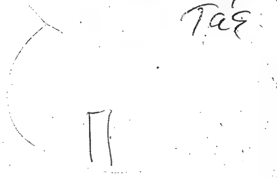
$1 \cdot 20 = 20 = 1$

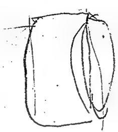
$(1\,3/4)^2 \cdot 12 = 36.72$

$$\begin{array}{r} 3.06 \\ 12 \\ \hline 36.72 \end{array} \qquad 1\,3/4 \qquad \frac{36}{20}$$



Dec ~~22~~ 18 1878
TAE





Arms for
cooling

Dec 18
1878 TAE

in the hand

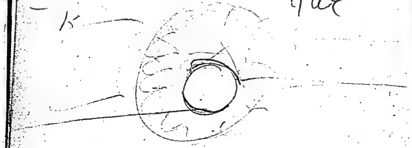
No force of gravitation
condition of matter

 Gramme

Cut down useless resistance

Bigger wire
Cold

Dec 18 78
TAE



Iron very rare no knowledge of Elec.

10
8 2 10

$C = \frac{8\ 1}{2+10} = \frac{1}{12}$

10 Dec 18/1878
TAE

10 Ohm machine
10 " outside
1 H.P.

Effect $\underset{100}{200}$ calories in all

10
2

$12)200(166$
12
80
72
80

$12C^2 = 200$

$C^2 =$

166
34

$$\text{Heat} = C^2 R$$

$$(10 + 10) = 20$$

$$\overline{20 + 20}$$

1 H P

$$\frac{1}{10 + 10} = \frac{1}{20}$$

$$\frac{1}{400} \times 20 = \frac{1}{20} \text{ Heat}$$

$$\frac{2}{20 + 20} = \frac{1}{20} \quad 2 \text{ H. P.}$$

$$\frac{1}{400} \times 40 = \frac{1}{10} \text{ Heat}$$

$$C = \frac{E}{R} = \frac{2E}{2R}$$

Dec 18 1878
T. A. E

100

Electric Light Dec 18th 1878

Chas Batchelor

Small Gramme Machine from Princeton

heats a

Platinum wire to dull red } $22\frac{5}{8}$ inch long
(only just see it)

11 cells Carbon & H large battery } is exactly
(pretty well played out)

equal to it

Size of Platinum wire ~~###~~ ·01

Length ———— $22\frac{5}{8}$ inches

Resistance ———— 2·3 ohms

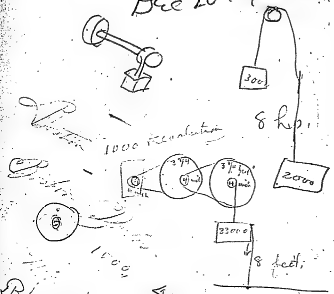
11 cells made new heat $35\frac{1}{4}$ in wire

of 3·47 ohms

8 cells = the Gramme

Bell telephone with C

Dec 20 1878 TAE



Boston

12.5

2750

33000

4

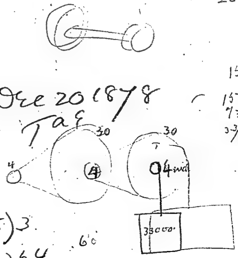
5.

8 6000

1. 12.5

8 inch

2000 feet



150. 30

15 2

7½ 4

3¾ .8 60

Dec 20 1878 TAE

125)3.

264 .60

1. 90 × 90 = 8100

20 × 60 = 1200

33000 (132.
250
800
750
500

20 × 20 = 400

30 × 30 = 900

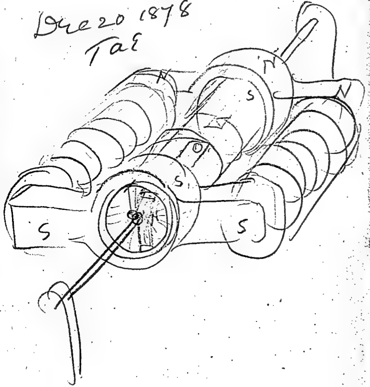
33 × 33 = 99, 99, 1089

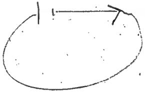
32 × 32 = 64, 96, 1024

Resistance with wire

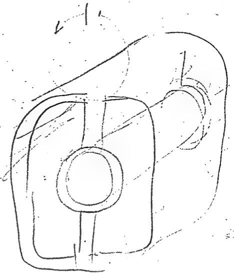
.9 Ohm

Dec 20 1878
TAE





Dec 20
1878 TAE



106

66 Cells per minute

5.5 : 9 :: 90
9
5.5)810 (14
55
260
220
400

Dec 20 1878 Jal

12

140-00,

7
24 . 21 .

Gramme Mach with 100 ohms resistance 107

90 turns per min 5.5

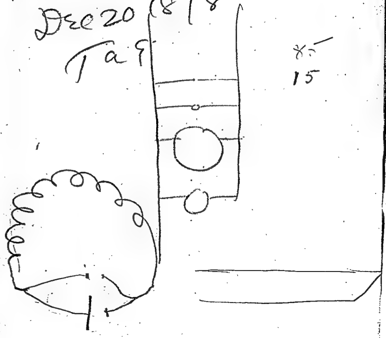
~~204 " " "~~ ~~11~~

~~75 L~~ ~~9~~

180 11.5

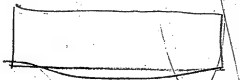
Dec 20 1878
TAE

85
15

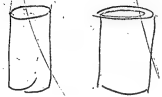


85
13

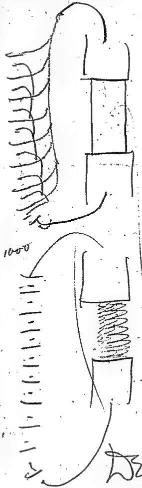
15)88 (85
75
100



Dec 20 1878 TAE



$\frac{1}{100}$ $\frac{1}{\text{ohm}}$



Heat
or Temperature $= C^2R$

Wanted Heat = 1 unit

$(10^2) \times \frac{1}{100} = 1$

C = 10

$\frac{1}{1000}$ Ohm

C = .10

Current = 10

Wanted heat = 1

1.1 = 1

1 Ohm
Ohm

Current = 1

Dec 20 1878
TAE

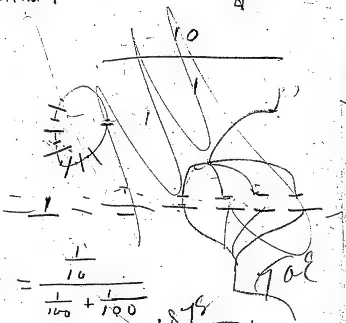
Heat = ~~10~~

Current ~~10~~

$\frac{1}{100}$ ohm

Current 1

1



$$C = \frac{\frac{1}{10}}{\frac{1}{100} + \frac{1}{100}}$$

TAE

Dec 20 1878

$\frac{1}{10}$ C $\frac{1}{10}$ $\frac{1}{1}$

C = 100

Ex. To heat thick bar

$\frac{1}{1000}$ of Ohm Battery
Machine

Better to use an intensity machine than no quantity machine to make intensity?

Battery nothing

Dec 20 1878
TAE

Heat = 1

Current = 100

$\frac{1}{100000}$

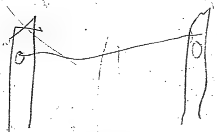
Current = 1

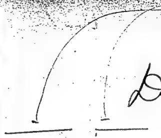
Heat = 1

Dec 20 1878 TAE

$$100 = \frac{1}{\frac{1}{10000} + \frac{1}{100}}$$

$\frac{1}{100}$ $\frac{1}{99}$ $\frac{1}{100}$





Dec 20 1878
TAE

Etheric force

If it were electricity of high tension there would be very small heating effects for even large sparks. This force will ~~[illegible]~~ cause iron to scintillate when the connection is made across ~~the~~ a file.

When a magnet is made and remade the whole air around it is placed in a diamagnetic condition

184

115

that is force has been exerted to bring it, thus when

Dec 20 1878
TAE

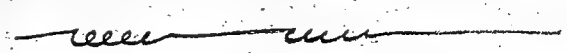
Relays made short so as to prevent induction answer much quicker

Cost per horse power 1 ct per hour (8/10)

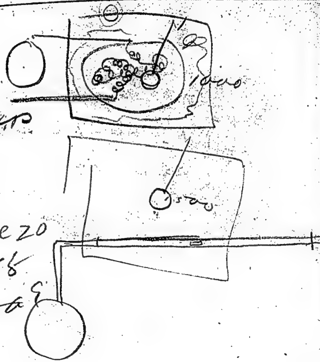
365
.10 hours a day
36.50
10 horse power to a machine
365.00
interest 10%

$\boxed{3650.00}$ $365 per year 36.50

Dec 20 1878
TAE

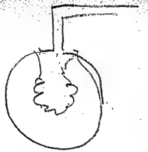


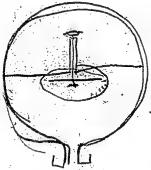
4/10 1500
1500



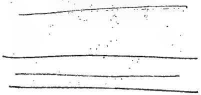
1 HP

Dec 20
1878
TAE

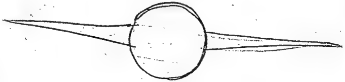


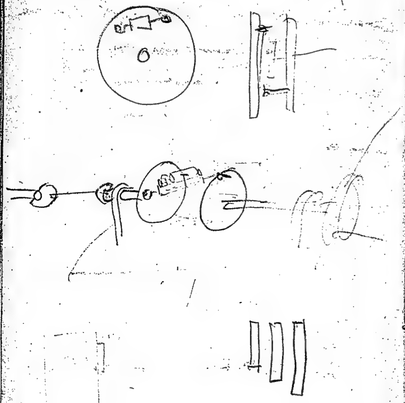


Dec 20
1878
TAE



Dec 20 1878
TAE





Dec 20 1878
TAE

Useless friction, as in the commutators, is much worse in a ~~tension machine~~ quantity machine than in a tension machine

Owing to dif % of loss

Machine 100 Ohm
Commutator 1 "

1% loss

Machine 1 100% loss
Commutator 1 of the total

Dec 20 1878
TAE

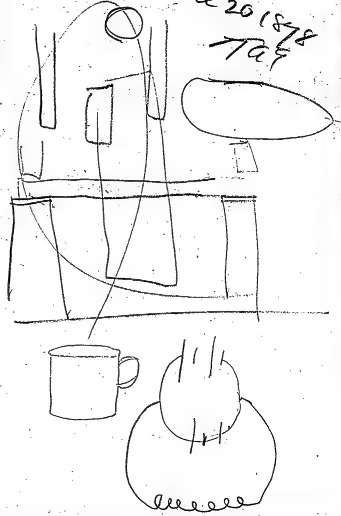
Wire brush commutators used to prevent dangerly vibrations. This could be effected with rod combined with mullers

Current is proportional to the weakest field magnet. The same as in induction currents

If the the magnets vary the friction will be increased to run the machine at a higher rate.

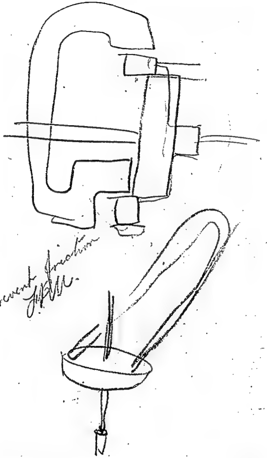
Dec 20 1878
TAE

Dec 20 1878
TAE



124 Dec 20 1878

TAE

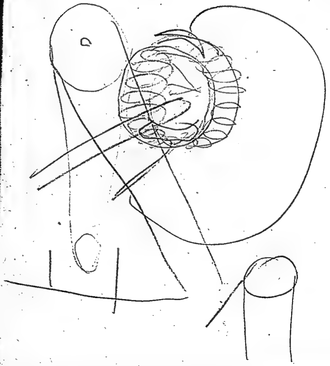


To prevent friction
JFW.

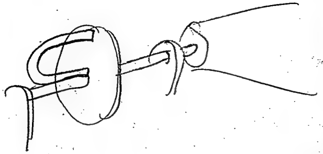
125

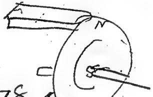
$\frac{1}{100}$

Dec 20 1878 TAE

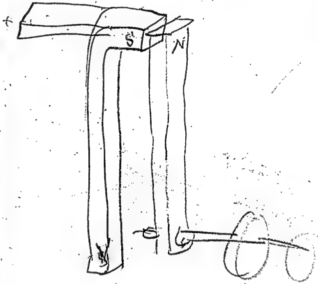


Dec 27 1878
TAE

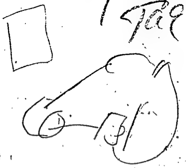


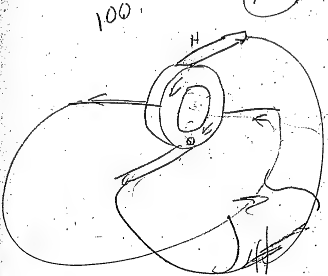


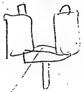
Dec 27 1878 TAE



Dec 27 1878
TAE







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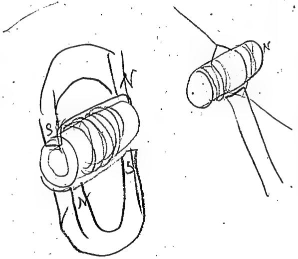
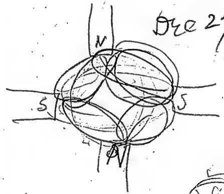
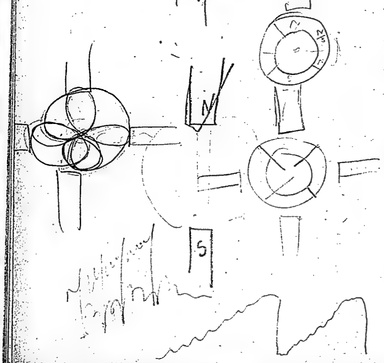


Dec 27 1878
T.A.E





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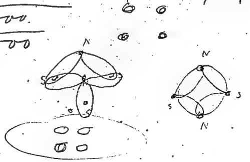
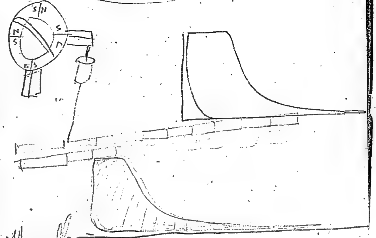




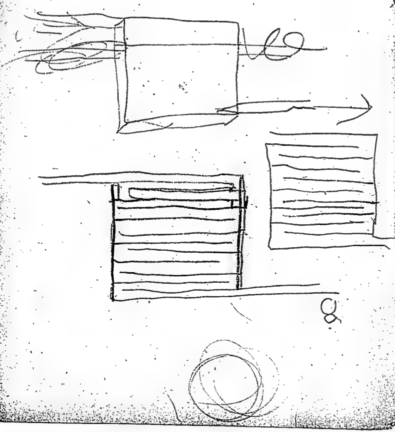
[illegible]

Heat trammeable

Elec " Dec 27 1878

TAE

Elec an turn round iron



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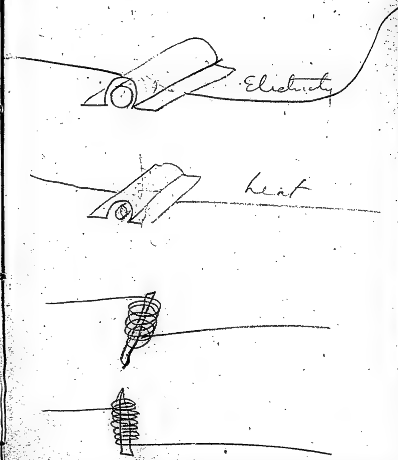
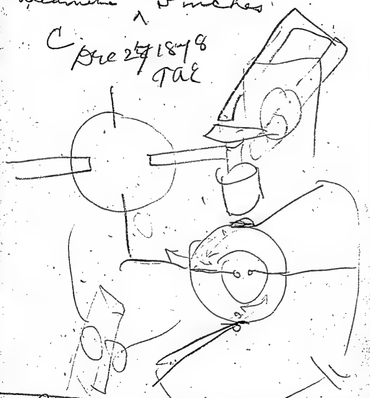


134

Coil 100 ~~feet~~

Diameter ^pipe^ 3 inches

C Dec 27 1878
TAE



See further

135

1. Resistance of bobbins H R
2. Proportion of field magnet to bobbin H M
3. Exterior resistance W
4. Total ^heat^ in machine H
5. Total heat in ~~field~~ outside W
6. Heat in field magnet due to close coiling H. M Dec 27 1878 TAE
7. Heat in ring bobbins due to coiling. H. R Cause. Small radiating surface Prevention Rotation and bringing air currents to the coils
8. Heat by demagnetization of the core H. R
9. Heat given off when quiescent or out of field H. R
10 C Resistance of commutators
11. Heat in field magnets H. M due to the passage of variable magnets across

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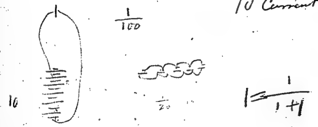
TAE

10 Current

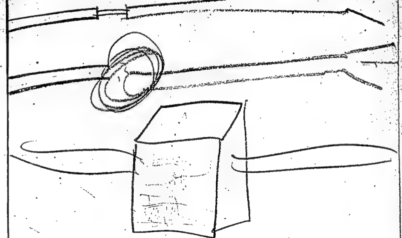


$$I = \frac{1}{\frac{1}{10}\quad\frac{1}{10000}}$$

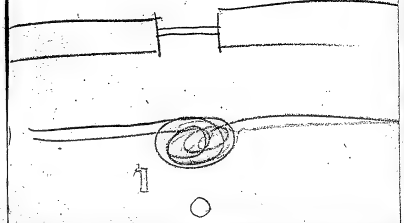
$$\frac{1}{10000}$$ 1000 Cells

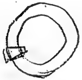
$$C = \frac{\frac{1}{10}}{\frac{1}{10000} + \frac{1}{10000}} = 500$$

1000 local action



Dec 28 1878
TAE





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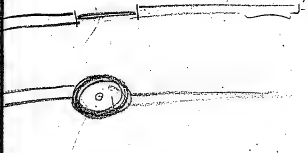
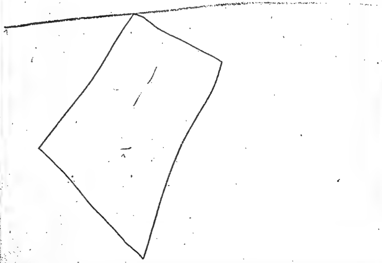


95. 5. 10

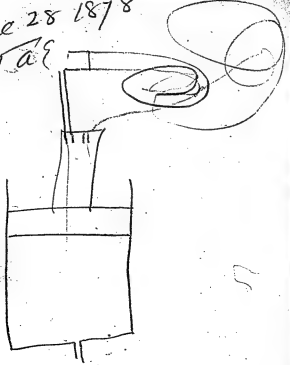


162 Light   If it were not   Dec 28 1878 TAE
for the eye, it could not
have been detected by any
know reaction, except th decom-
position of a few salts and a
slight indication on the Thermo-
pile. Suppose the race were
blind to ~~heat~~ light as they are to
chemical rays ~~it would have~~
and had eyes which only
measured heat rays, it would
have probably been many years
before the light would have
been missed in the doctrine
of the conservation of Energy
For example only $\frac{1}{1000}$ of the
Energy of a gas Flame is
given off in ~~....~~ light,
and the experiments for

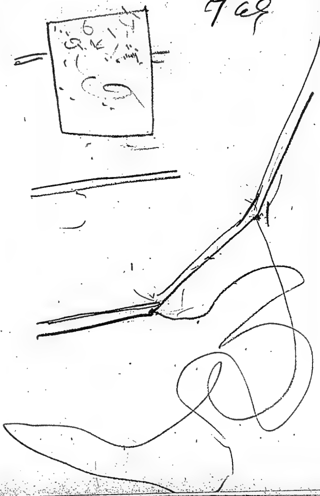
measuring the energy of   163
a flame show more probable
error than this.

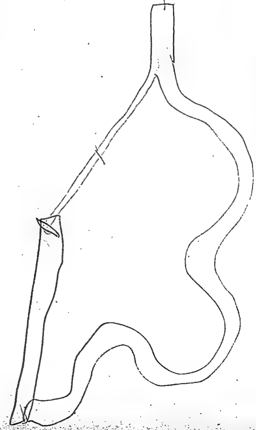
Dec 28 1878
TAE

Dec 28 1878
TAE



Dec 28 1878
TAE





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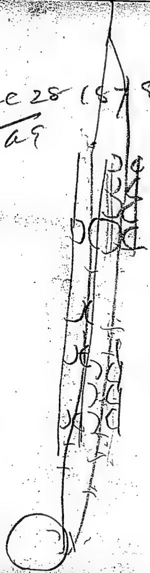
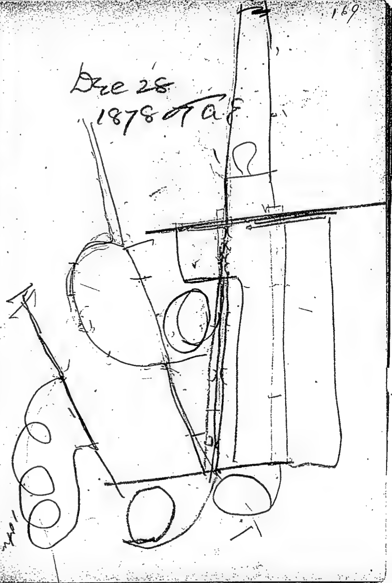
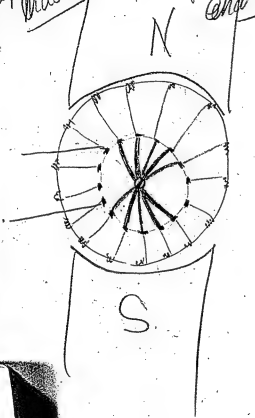


Dec 28
1878 TAE

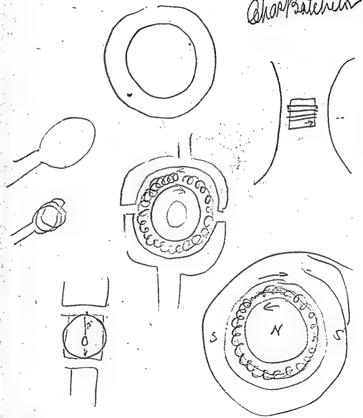


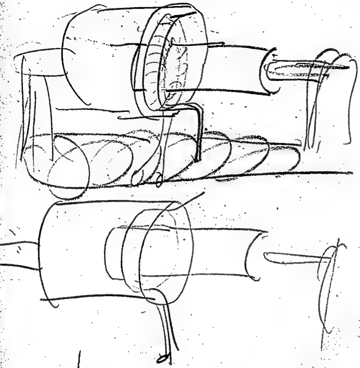
Magneto Electric Machine

Jan 1st 1878
Chas Batchelor



Dec 28. 1878
TAE
Chas Batchelor





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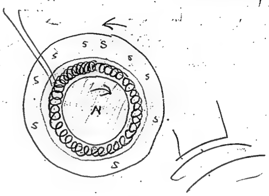

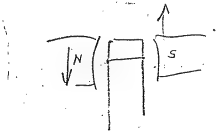

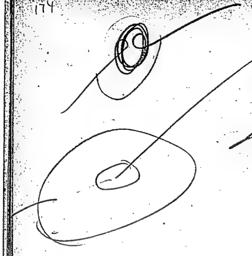

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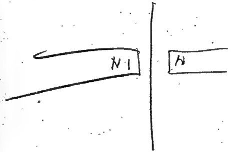
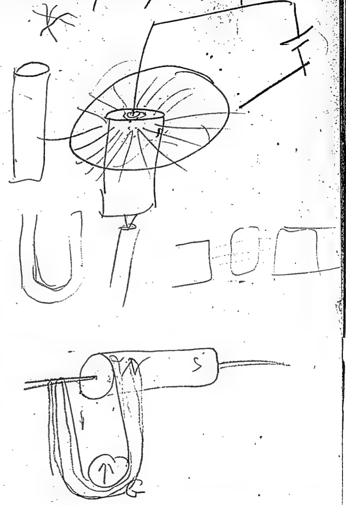


Dec 29 1878 TAE



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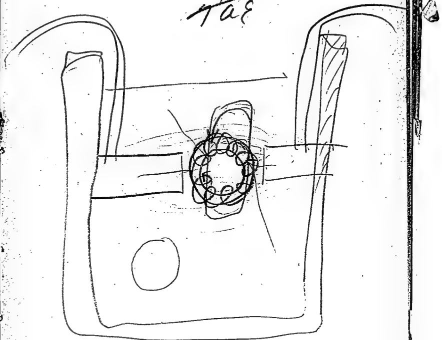
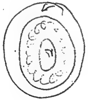
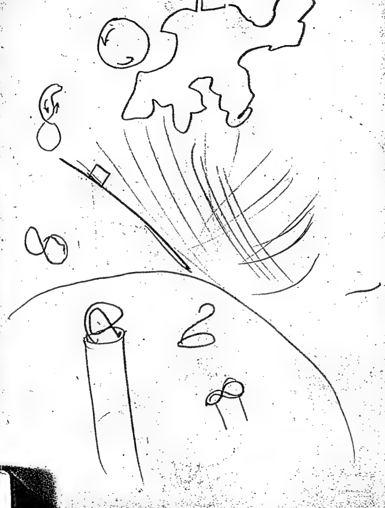
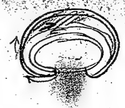




Dec 29 1878 TAE





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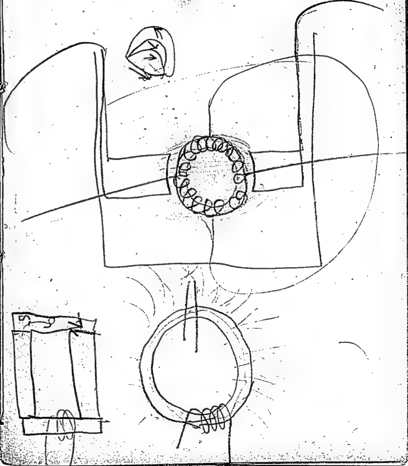

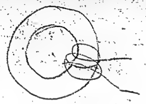

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Ex. Take a bar of steel hardened perfectly evenly carry a coil about one foot for $\frac{1}{4}$ of the whole** Pass a current and then break the the bar when it has ceased and see if there are poles.

** Better coil evenly entirely round and move the coil if possible

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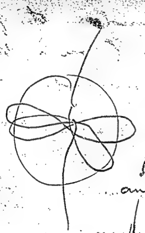
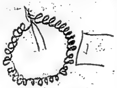
Would heat travel faster up or down ~~af~~ in the vacuum

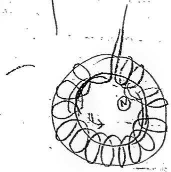
When a Bell telephone a motion is given to one diaphragm the other in answering will give a return current when it returns and so an echo as it were, will be made and a humming sound will result.

In clocks the pendulum will pick up earth currents and thus they will change their rates of movement if their direction is changed





This was also revolved in both fields and in one and no current.



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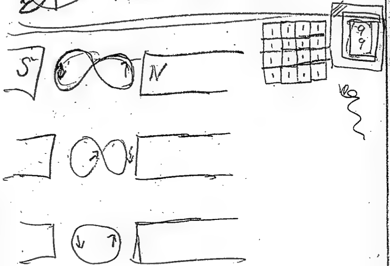
Wire wound in the form of a figure 8 on a wheel and revolved

No current



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TAE

Phosphorescence may be called the induction of light. The induction of Elec. means that a wire has had its matter put under a strain which when removed gives a current. Do any substance when exposed to light absorbs it and when the light is removed gives it out as phosphorescence

Sun 65 or 70 miles only the distance of the atmosphere

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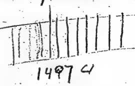
Dec 29. 1878 TAE

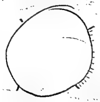


Sun spectrum

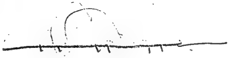
Line 1474 projects out of spectrum

When looking through the spectroscope at the reflection continuous spectrum in as clear atmosphere, the Mr. E noticed that light streaks seemed to run across the spectrum. He noticed that a small cloud gave the same effect very strong and supposed that the phenomena was due to invisible vapor in the air

Dec 29
1878
TAE



Diffraction
grating by rotation



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~~200 000~~) 9000000 (
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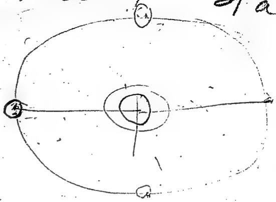

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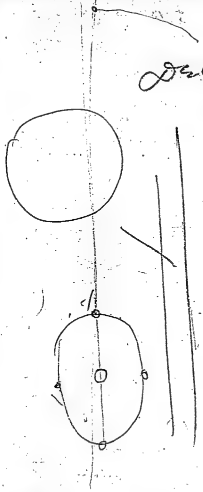

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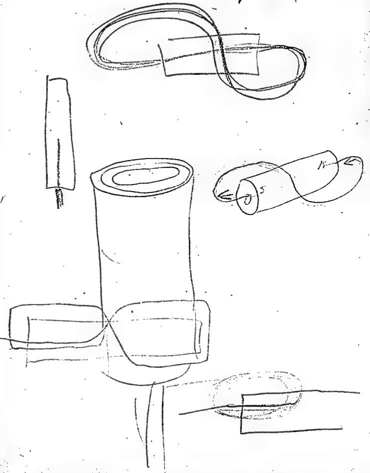

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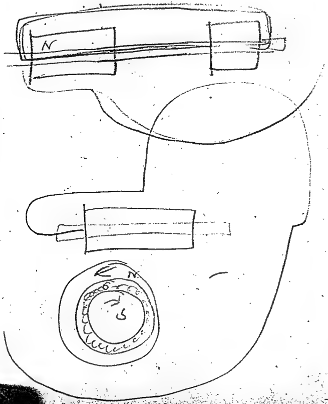

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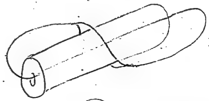
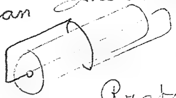
Portland
Portchester
Port
Portland



Por

Bostonian

Protochloride



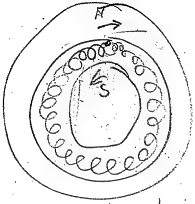
Protochlo

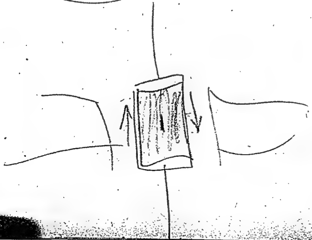
Protochloride

Boston

Dec 30 1878

TAE





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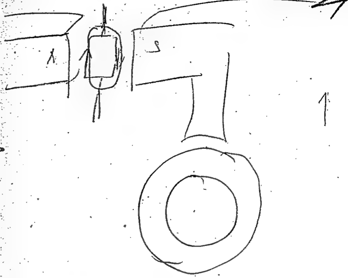

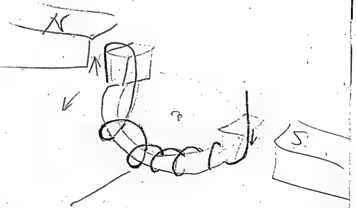

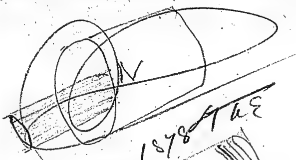

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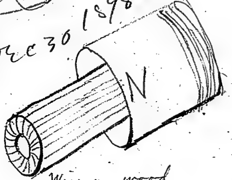

Wire on wood

Coil revolved and no current as it ought to be.

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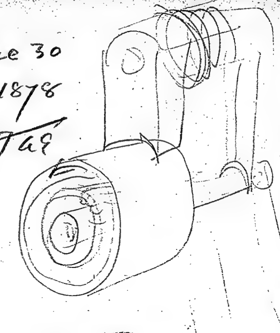

an electrometer may be considered as a galvanometer of great resistance. For example a 20.000 Ohmgalvanometer will give indications exactly corresponding to the electromotive force of a battery. If we considered that we take a galvanometer which works with a resistance equal to the air leakage of a charged plate it must have a resistance to be counted by the ~~100000~~ hundreds of thousand of Ohms. All ordinary resistances would be neglected in comparison

The electromotive force is dependent on the chemical force existing between the substance and its exciting liquid or solid. The current depends on the number of molecules changing condition

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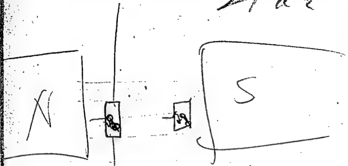

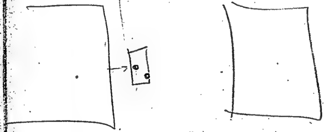

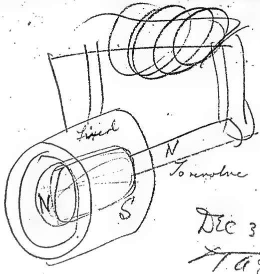

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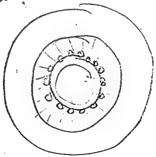
No current.



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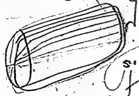
TAE

Francis Upton Esq Peabody Massachusetts

Upton

Upton Francis



Francis

Siemens Alternic

Siemens Alternick

Dec 30 1878

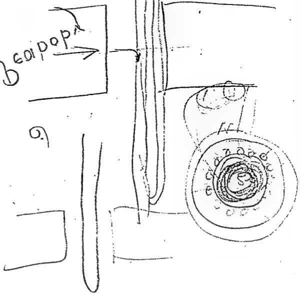
TAE

Francis

Upton Francis

Peabody

Peabody



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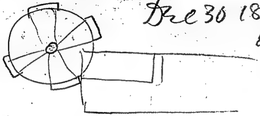

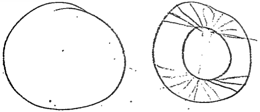

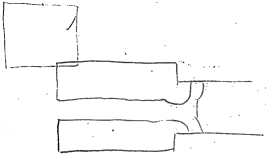

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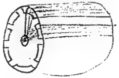

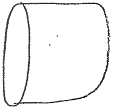

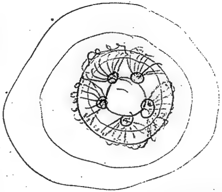

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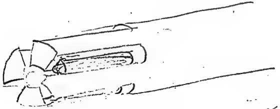

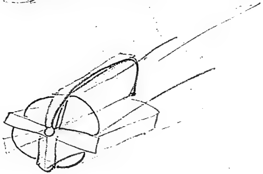

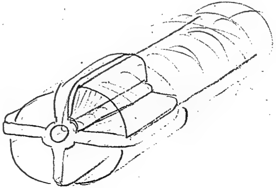

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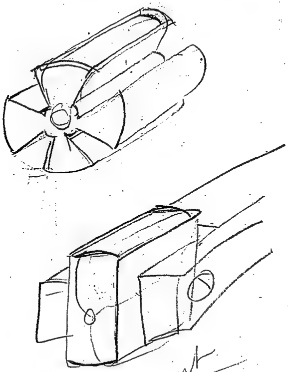

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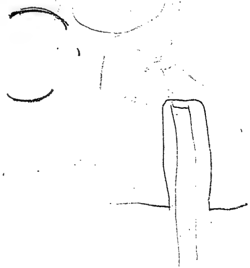

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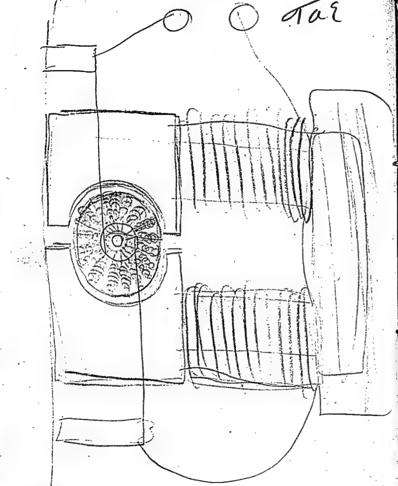

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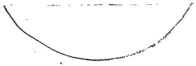
Laboratory Note Book No. 10.

Pages 212 to 215.

Dynamo Machine.

See Edison Patent:

222,881



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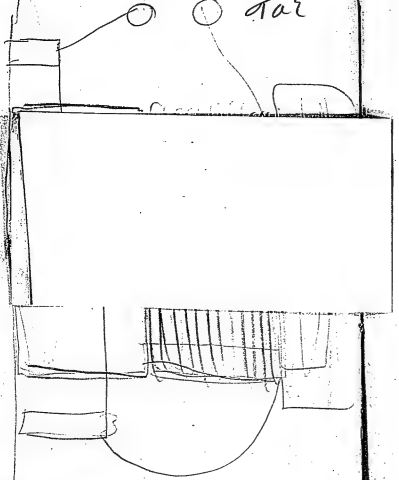

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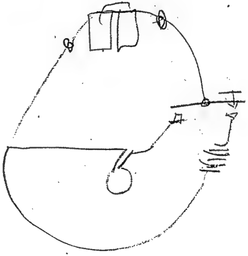

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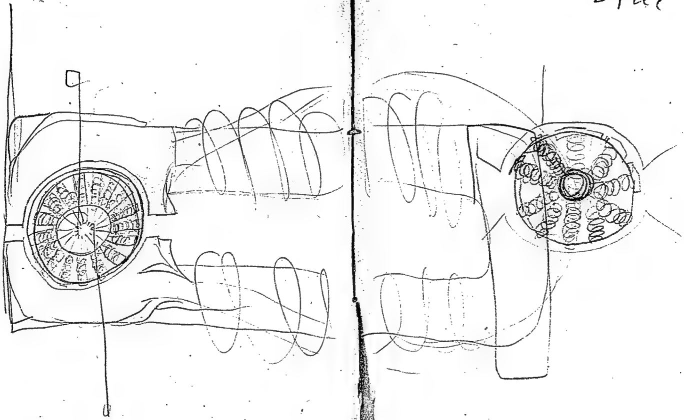

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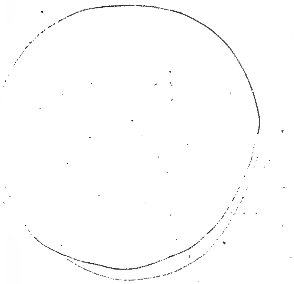

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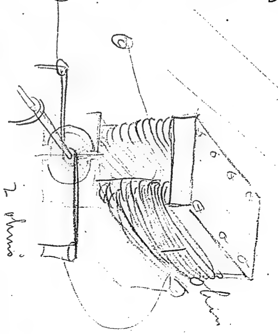
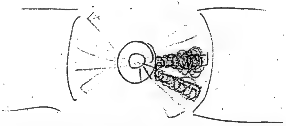
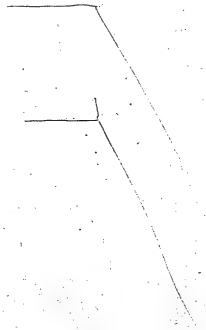


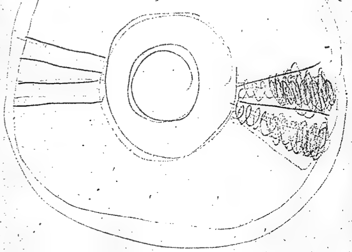




Armature 5 X 9

Dec 30 1878

795



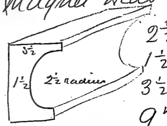
New Magneto Mach   Dec 30 1878

Armature Cylinder   C Batchelor

9in long
5 " ~~thick~~ diameter
$\frac{1}{4}$ " thick

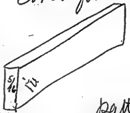
Shaft for same
9" long
2" thick   round solid

Magnet Head



$2\frac{1}{2}$ radius
$1\frac{1}{2}$ thick
$3\frac{1}{2}$ broad.
9in long

Cores for armature Spools



$1\frac{1}{4}$ in deep. (long)
5/16 " thick
wide

pattern

Pitch of thread 10

Wheel (driving)

Diam - 9.61 in

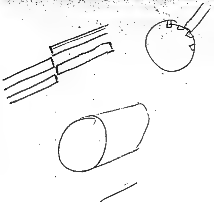
Pitch " 9.55

Width 5/8 in

hole in hub 1 in

Disc spokes

300 teeth (spiral cut)



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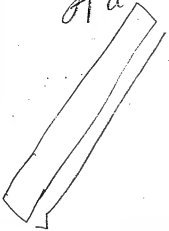

Armatures for same

Edison Armature

Siemens Armature

Gramme Armature

Siemens Armature with
Stationery Magnet

226

Chas Batchelor Dec 31 1878 227

Edisons Magneto Electric Mach.

1 Commutator finely divided

2 Armature must be made to revolve round a stationery core so

3 The stationery core must be wound with wire and put in circuit with field magnets thus putting part of field in most concentrated part.

4 The armature & poles will then stand thus:-

so that we throw loops through a very concentrated field

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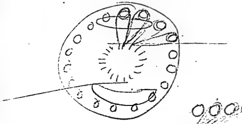
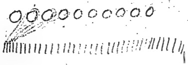
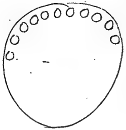
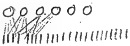






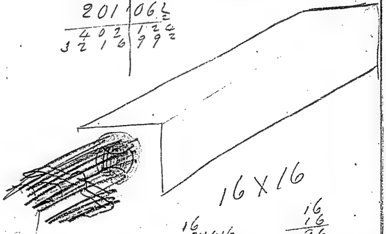


Edison's Mag. Elec Generator Dec 31st 1878
Chas Batchelor

5

.2607 lb

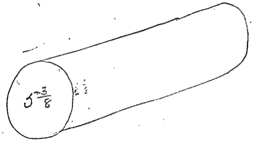
201 | 062½
402 | 124½
3216 | 99½



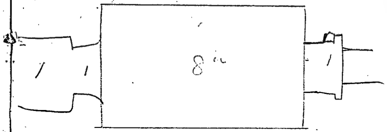
16 X 16

16	16
3.1416	16
6.2832	96
50.2656	16
.7854	256.00

3217
.2607
22519
19302
6434
838.6719



5 3/8 X 16 X 4
2 11/16 X 8 X 4



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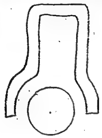

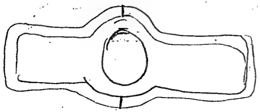

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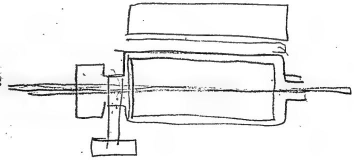

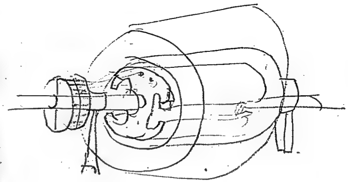

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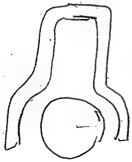

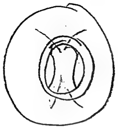

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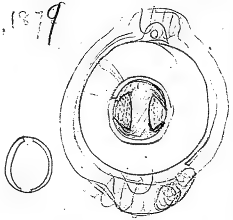

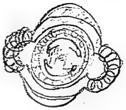

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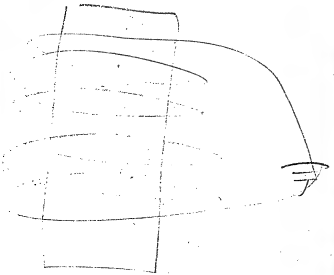

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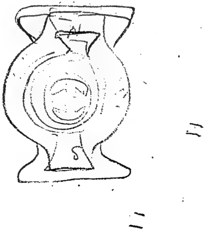

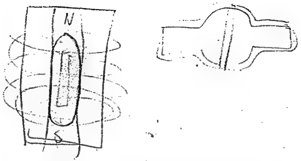

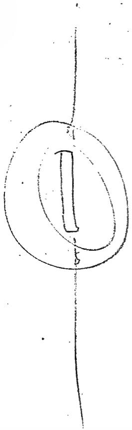
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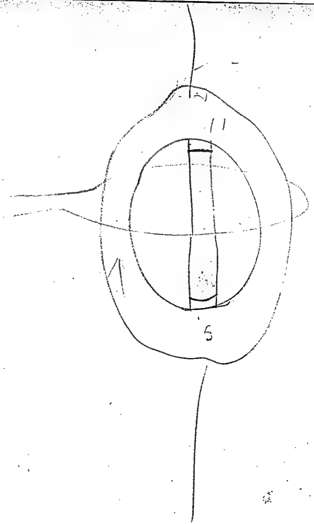
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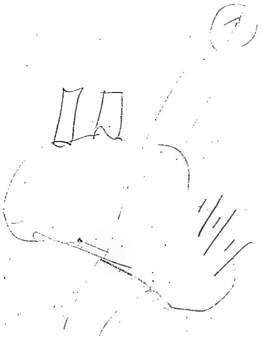
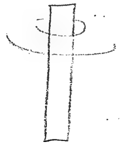
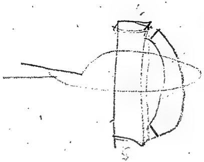
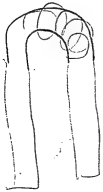
46° 15′

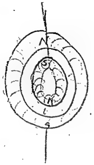
45° 30′







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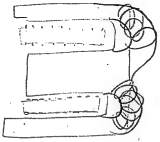

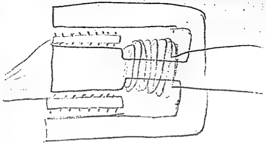

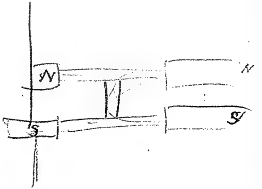
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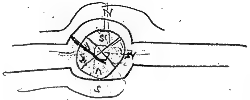
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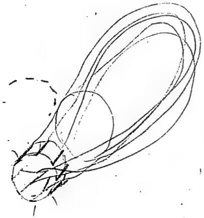

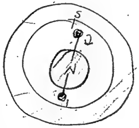
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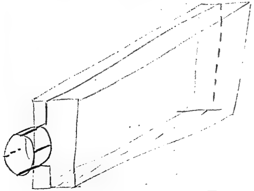
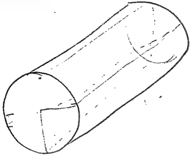
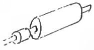
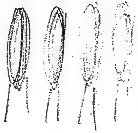


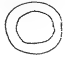


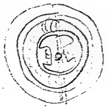
Electro Magnetic Mach.

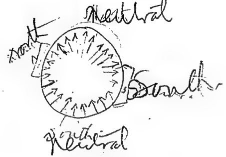
Jan 1 1879
Chas Batchelor







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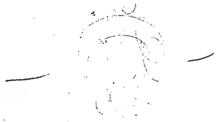

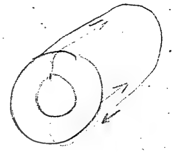

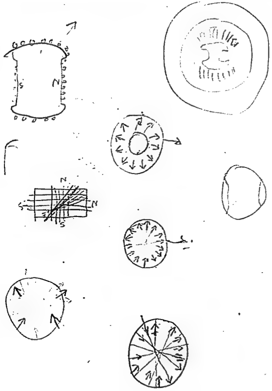
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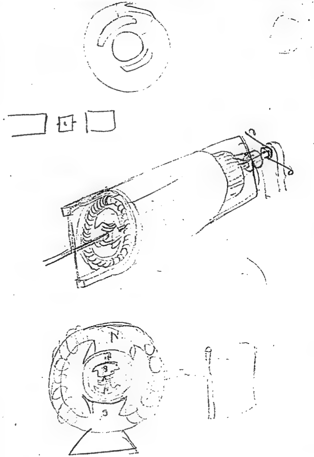
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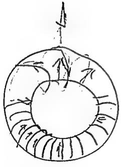

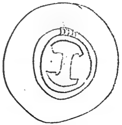

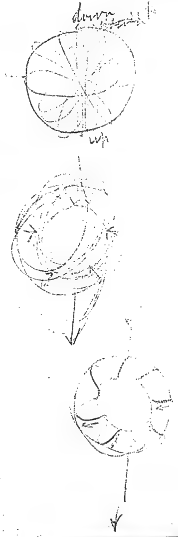
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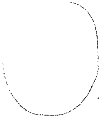

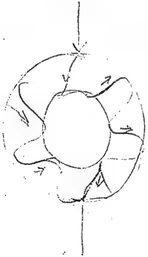

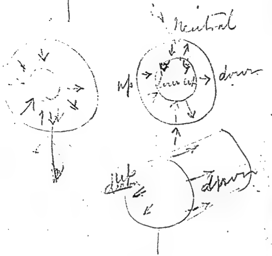
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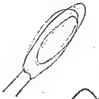

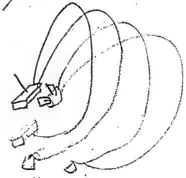

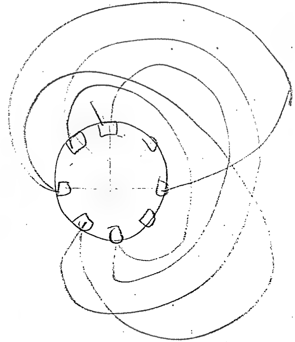

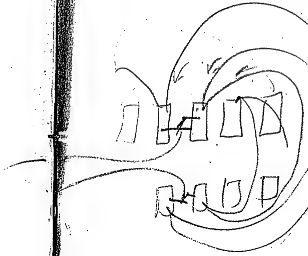

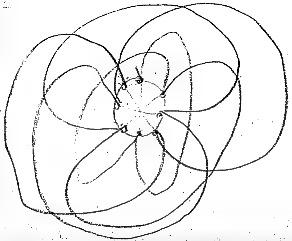

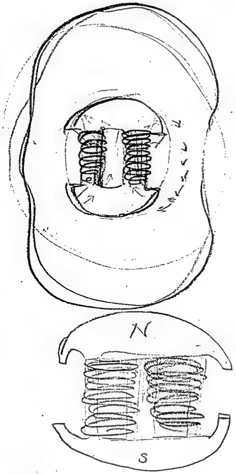
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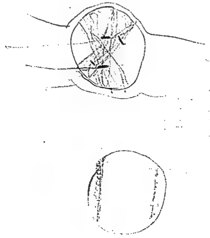

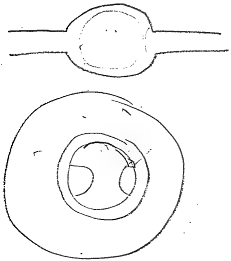

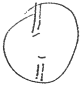

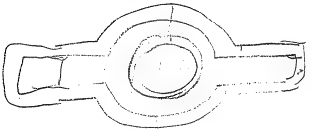

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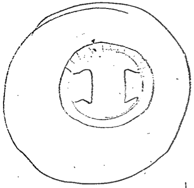

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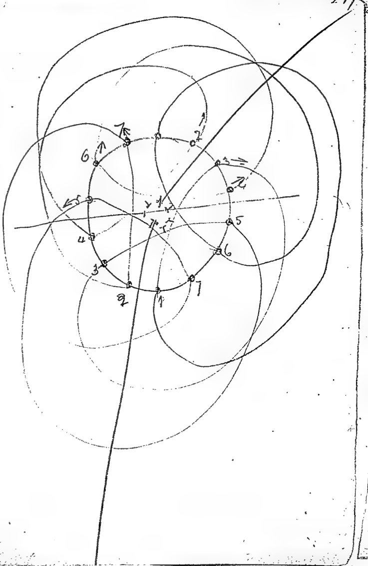

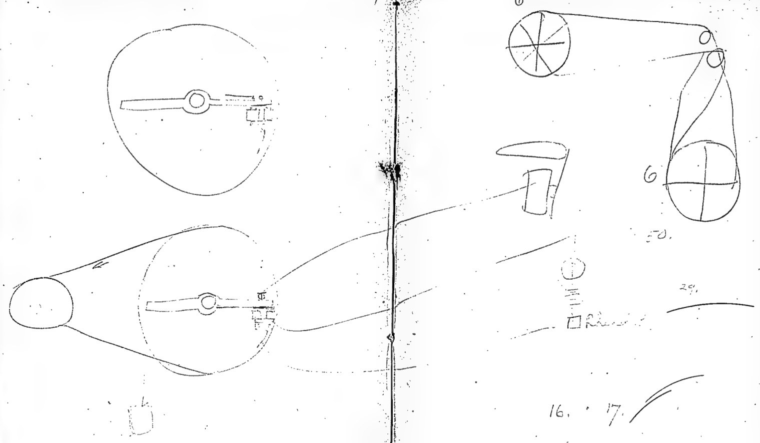

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